PRINTED CIRCUIT BOARD MANUFACTURING

COMPLIANCE ASSISTANCE PROGRAM

California Environmental Protection Agency
AIR RESOURCES BOARD

July 1998

Acknowledgments

We greatly appreciate the assistance given in developing this manual by those within industry and governmental agencies. A special thank you to the following for their comments and special effort:

Carol Allen	Bay Area Air Quality Management District
Debi Emery	Praegitzer Industries
Tony J. Gambardella	Bay Area Air Quality Management District
Katherine M. Hart	U.S. Environmental Protection Agency
Kenneth Hinaga	Westak
Steven E. Hoover	U.S. Environmental Protection Agency
Ted Hull	Bay Area Air Quality Management District
Harold Lips	Bay Area Air Quality Management District
Alisa W. Gee	Proto Engineering Corporation
George LaBar	Printed Circuit Alliance
Donald E. Leary	Progressive Circuit Products
Jay McKeeman	Kahl Associates
David Moralez	Ventura County Air Pollution Control District
Jim Neal	Viktron California
Douglas F. Grapple	Santa Barbara County Air Pollution Control District
Shailesh Patel	South Coast Air Quality Management District
Barry Nickolson	Sigma Circuits
Dianne Patterson	Hallmark Circuits
Mostafa Pournejat	Zycon
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Bruce Tuter	San Joaquin Valley Air Pollution Control District
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100 INTRODUCTION

Air Quality Program

California leads the nation in cleaning up the air. In 1955 the Bureau of Air Sanitation began identifying the air pollution levels that could endanger public health. Recognizing cars and trucks as a major cause of smog problems, the State formed the Motor Vehicle Pollution Control Board (MVPCB) in 1960 to regulate tailpipe emissions. California was the first state to adopt vehicle emission standards for hydrocarbons (HC) and carbon monoxide (CO).

ARB Created

In 1967 the MVPCB and the Bureau of Air Sanitation were combined to create the Air Resources Board (ARB). With this merger, the authority to define the health threat of air pollution and to regulate its causes was united in a single organization. Since then, the ARB, working with county air pollution control districts (APCDs) and regional air quality management districts (AQMDs) has created one of the world's most comprehensive air quality control programs.

In July 1991 the California Environmental Protection Agency was formed to bring together under a single, accountable, Cabinet level agency these entities: the Department of Pesticide Regulation, the Department of Toxic Substances Control, the Office of Environmental Health and Hazard Assessment, the Integrated Waste Management Board, the State Water Resources Control Board, nine Regional Water Quality Control Boards, and the Air Resources Board.

What Does ARB Do?

What does the ARB do? As the primary statutory authority, the ARB establishes and enforces standards to limit pollutant emissions from motor vehicles. The ARB does more:

1. Conducts inspections, in cooperation with APCDs, to ensure compliance with air pollution regulations by applying **consistent and evenhanded enforcement.**

2. Develops suggested rules and regulations to assist local APCDs in their efforts to improve the air quality.

3. Establishes air quality standards to protect the health of the most vulnerable members of the general population and to prevent damage to property and crops.

4. Evaluates the effectiveness of pollutant control strategies for vehicles and industrial sources.

5. Monitors air quality throughout the State.

6. Conducts extensive research programs.

The ARB's past efforts have reduced the pollution emitted from vehicles and other large sources. Now, and for the future, the ARB is focused on smaller, individual sources of pollution. However, successfully regulating a very large number of very small, diverse sources poses even greater challenges than previous clean air measures. Continuing to improve the air quality requires hard work and careful planning.

101 COMPLIANCE ASSISTANCE PROGRAM

Compliance Assistance Program (CAP)

The Compliance Assistance Program (CAP), created in 1988 by ARB, assists local air districts in conducting more comprehensive, consistent, and accurate facility compliance inspections. The CAP program also provides industry with information and tools, in the form of self-help publications, which clarify compliance requirements and help explain how to stay in compliance with air pollution rules and regulations. CAP also assists industry in establishing their own compliance inspection programs. By conducting routine compliance inspections, facilities can stay in compliance on a daily basis and can thereby avoid costly air pollution violations.

Enforcement audits of some industrial sources have shown noncompliance rates as high as 50 percent. Improving these rates can bring rewards to everyone.

Based on the idea that sources will comply if they understand what is required of them, CAP identifies requirements of regulations and presents them in several more readily understandable formats. These CAP publications can assist industries to monitor themselves and to conduct their own daily inspections, thus increasing their compliance rates, and reducing costly violations. Through the development and distribution of these rule-specific publications, CAP creates a flow of information in a variety of useful forms:

Publications

Handbooks. Easy-to-read, colorfully illustrated handbooks are developed for the industrial labor force. Most **can be read in 10 minutes or less** and all contain helpful self-inspection checklists.

Pamphlets. Quick-reference pamphlets contain detailed flow charts, checklists,

and helpful diagrams. These are designed for facility managers and industry's environmental managers.

Technical Manuals. Detailed technical inspection manuals are developed for industry environmental managers, ARB inspectors, and local air district inspectors. These contain rule information, process description, and step-by-step procedures for compliance inspections.

102 MANUAL PURPOSE AND USE

Manual Description

This manual is designed to assist local air pollution control district inspectors in conducting complete, consistent, and efficient compliance inspections. It is also designed to supplement, but not replace the operating manuals and various operator training courses that vendors provide their clients.

This manual contains a description of the processes and emission control technologies, a discussion of regulatory requirements at the Federal, State and local level, and a detailed description of facility inspection procedures. Also contained in this manual are a glossary and air pollution control definitions and terms, appendices with additional reference material which can be reproduced for use in the field, and a comprehensive index.

This manual is designed to address the equipment, operations, and air pollution control regulations applicable in the State of California.

As a reference document, this manual is divided into numbered sections and subsections, with key topic words identified in the outside scholar margins.

102.1 FOCUS: TARGET AUDIENCE

Who Will Use This Manual?

The primary focus of the Compliance Assistance Program is to improve the knowledge of inspectors and industrial operators. In order to reduce noncompliance and excess emissions, both the inspector and the operator need to know what is regulated, why it is regulated, and how compliance is determined.

This technical manual was written because the target audience consists mainly of corporate and industrial managers and their staffs, including production environmental managers, ARB inspectors, and a few district inspectors. Since

the nature of the subject is too diverse to be treated adequately in a short handbook, CAP staff decided to use the more detailed technical manual to present the pertinent information.

Because the manual is a pioneering effort in a relatively new and emerging area some of the material in this manual may be of use to others besides the "target audience."

103 MANUAL MAINTENANCE

Comments Or Questions

This manual is a dynamic reference document. To keep this manual accurate and current, CAP staff rely heavily on district inspector experience and industry personnel expertise. As changes or improvement issues concerning this technical manual are raised, users should make note of them. All comments should then be forwarded to:

Air Resources Board
Compliance Division
Compliance Assistance Program
P.O. Box 2815
Sacramento, CA 95812

Comments are reviewed as they are received and if any proposed amendments need immediate attention, changes will be made as soon as possible. A draft of the revised technical manual will then be provided for comment to all local districts. For proposed changes which are less critical, several will be accumulated before any changes are made. If regulations change significantly or new information on equipment and processes becomes significant, a technical manual update package will be prepared and sent to all users who have completed and returned a Manual Tracking Card.

Manual Tracking Cards

A Manual Tracking Card is located at the front of this manual. It is important that each recipient of one of these manuals complete and return a card to the address listed previously. Technical manual upgrade packages will only be sent to those who have completed and returned this card.

200 CATEGORY DESCRIPTION

Printed Circuit Boards

Foundation for all Electronics

A printed circuit board (PCB) is the foundation both literally and figuratively for virtually all electronic devices. It is the platform upon which electronic components such as integrated circuit chips and capacitors are mounted. The PCB, or printed wiring board (PWB) provides both the physical structure for mounting and holding electronic components as well as the electrical interconnection between components. A PCB consists of a nonconducting substrate (typically fiberglass with epoxy resin) upon which a conductive pattern or circuitry is formed. Copper is the most prevalent conductor, although nickel, silver, tin, tin-lead, and gold may also be used as etch-resists or top-level metal.

There are three types of PCBs: single-sided, double-sided, and multilayer. Single-sided boards have a conductive pattern on one side only, double-sided boards have conductive patterns on both faces, and multilayer boards consist of alternating layers of conductor and insulating material bonded together. The conductive layers are connected by plated through-holes, which may be used to mount and electrically connect components. PCBs may also be either rigid, flexible, or a combination of the two (rigid-flex).

Printed Circuit Assembly

When the electronic components have been mounted on the PCB, the combination of PCB and components is an electronic assembly, also called a printed circuit assembly (PCA). This assembly is the basic building block for all larger electronic systems, from toys to toasters to telecommunications.

U.S. Competitiveness

These electronic systems, in turn, support every other critical technology in the United States. To quote the Council on Competitiveness from their 1991 Gaining New Ground report, "Electronic components are playing an especially important role in driving improvements in information and communication technologies, which in turn are enabling advances in all manufacturing and service industries."

PCBs play a crucial role in these improvements because advances in electronic packaging and interconnections reduce the size and cost of electronic devices while boosting performance. Progress in PCB technology and manufacturing drives U.S. competitiveness in both existing products and new technologies. The U.S. Department of Defense, the U.S. Department of Commerce, the Japanese Ministry of International Trade and Industry, and the European Community all include electronic systems and components on their critical technology lists. A summary of the market share for the various groups is given in Figure 200.1.

200 CATEGORY DESCRIPTION

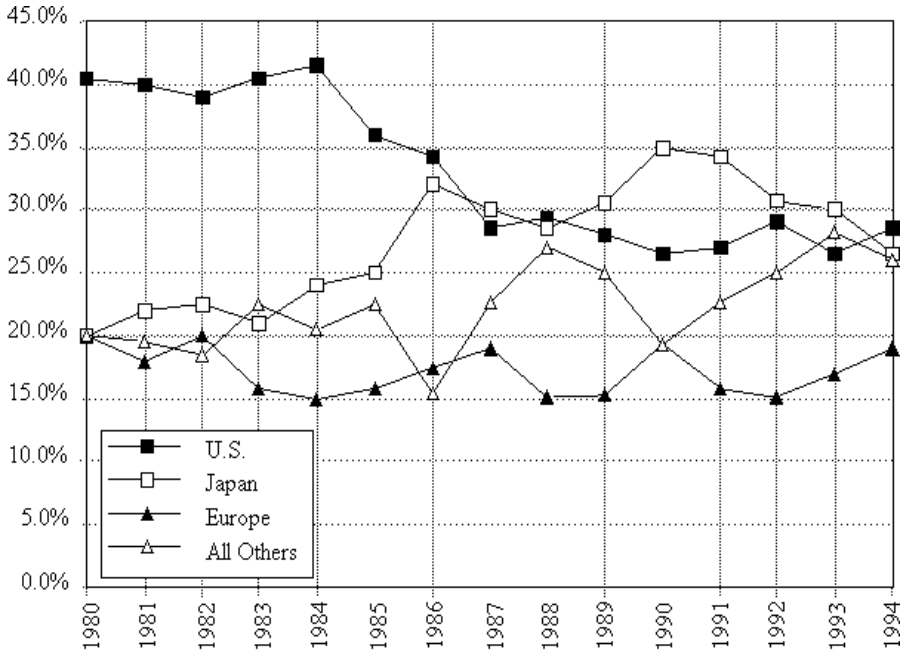


Figure 200.1
Historical World Market Share for Rigid and Flexible Circuits
(based on U.S. dollars)

201 MAJOR DOMESTIC MARKETS AND TRENDS

The seven basic markets for printed circuit boards are described below.

Seven Basic Markets for PCBs

- **Automotive:** engine and drive performance, convenience and safety, entertainment (radios), and other applications for diagnostics display and security.

- **Communication:** mobile radio, touch tone phones, portable communication, pagers, data transmissions, microwave relay, telecommunications and telephone switching equipment, and navigation instruments.

- **Consumer Electronics:** watches, clocks, portable calculators, musical instruments, electronic games, large appliances, microwave ovens, pinball/arcade games, television, home entertainment, video recorders, and smoke and intrusion detection systems.

- **Computer/Business Equipment:** mainframe computers, mini computers, broad level processors, add-on memory, input/output devices, terminals, printers, copy machines, facsimile machines, word processors, cash registers, teaching machines, gas pumps, and taxi meters.

- **Government/Military/Aerospace:** radar, guidance and control systems, communication and navigation, electronic warfare, ground support, sonar ordinance, missiles, and satellite and related systems.

- **Industrial Electronics:** machine and process control, production test and measurement, material handling, machining equipment, pollution, energy, and safety equipment, numerical controls, power controls, sensors, and weighing equipment.

- **Instrumentation:** test and measurement equipment, medical instruments and medical testers, analytical, nuclear, lasers, scientific instruments, and implant devices.

Computers are the U.S. Market for PCB's

Computers are the major U.S. market for PCBs, with communications being the second largest application market. The Institute for Interconnecting and Packaging Electronic Circuits (IPC) indicates that nearly 39 percent of printed circuit boards produced in 1993 were used by the computer market, while 22 percent were used by the communication industry.

According to Microelectronics and Computer Technology Corporation's (MCC) *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry,* PCB manufacturing is the most chemical intensive process in the building of a computer workstation.

200 CATEGORY DESCRIPTION

201.1 INDEPENDENT VS. CAPTIVE PRODUCTION

Independent Production

PCBs are produced by two types of manufacturers: independent and captive. An independent or merchant manufacturer produces PCBs for sale on the open market, to be used in electronic products such as TVs, computers, and so forth. Independent PCB manufacturers are thus competing with each other in a global market to secure orders or contracts from customers. Typically, independent PCB manufacturers bid on their ability to make a product as specified by the customer; the PCBs or electronic interconnection products are almost always custom designed.

Captive Production

A captive manufacturer is also known as a Original Equipment Manufacturer or OEM. These companies manufacture PCBs for use internally in their own electronic products. Texas Instrument and AT&T are examples of OEMs. Some OEMs, such as IBM, which in the past have been exclusively captive manufacturers, have recently entered the merchant market as well. In the United States, the majority of PCBs are produced by independent manufacturers. Many OEMs have shut down their PCB operations and now buy their PCB from independent manufacturers. Unfortunately, as OEMs shut down their PCB manufacturing, they also discontinue research and development on new PCB manufacturing technology, processes, and materials. Because the average independent PCB manufacturer is orders-of-magnitude smaller than most OEMs, the independent PCB manufacturer lacks sufficient resources to conduct research on any scale approaching what the OEMs used to accomplish.

201.2 ECONOMIC TRENDS

World Market PCBs is Approximately $ 21 Billion a Year

The total world market for all PCBs is approximately $21 billion a year. The United States and Japan are the dominant leaders, although the "four tigers" (Hong Kong, Singapore, Taiwan, and Korea) have been increasing market share in recent years.

U.S. domination of this world market eroded from 1980 to 1990, but has increased slightly in recent years. Japan and the four tigers have been the pre-

dominant competitors who have captured the world market share lost by the United States. Japan is now seeing its own market dominance erode as the four tigers continue to capture market share.

One-quarter of the Market is Double-sided Rigid

201.3 DOMESTIC MARKET HISTORY/OVERVIEW

Since 1980, rigid multilayer PCBs have grown to dominate the domestic production value of all PCBs. Rigid multilayer boards now account for approximately 66% of the domestic market. One-quarter of the market is double-sided rigid boards, and the remainder are single-sided and flexible circuits. The market for multilayer boards has grown from approximately $700 million in 1980, to almost $3.4 billion in 1993. Figure 201.1 shows the history of this growth in the multilayer market. Shown in millions of dollars.

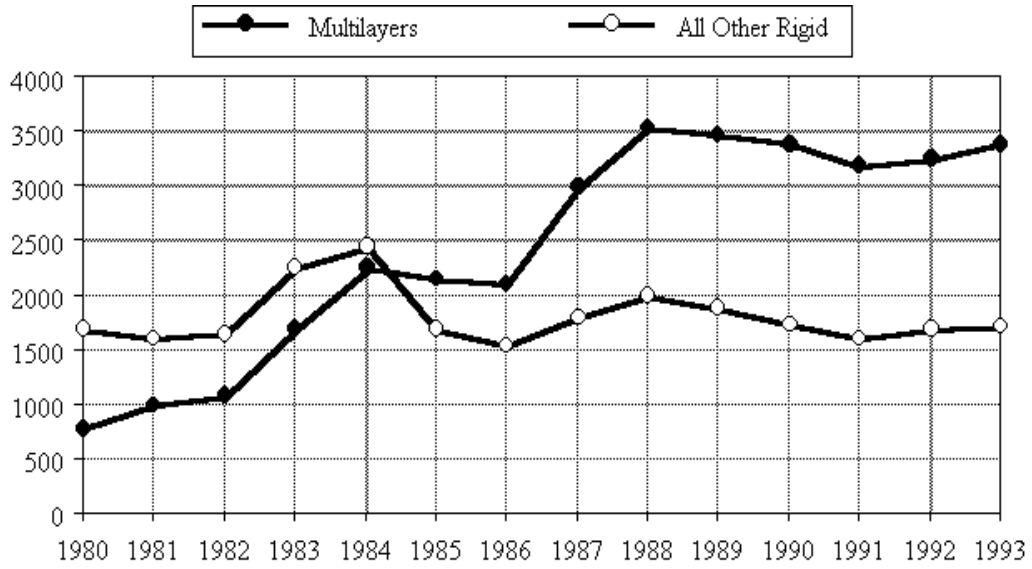


Figure 201.1
History of the Growth in the Multilayer Market

Multilayer Rigid Boards Dominate the Dollar Volume

Although multilayer rigid boards dominate the dollar volume of production, single-sided PCBs by far dominate the number of circuit boards produced in the United States. Of the approximately 1.3 million PCBs produced in the United States in 1993, almost 900,000 were single-sided and only 150,000 were multilayer boards. However, the average cost for a single-sided board is 58¢, while the average cost for a multilayer board is about $22.

The Trend is to Purchase PCBs from Smaller Independent Manufacturers

Another historical shift over the past ten years has been outsourcing PCB manufacturing. In 1980, captive OEM operations accounted for about 50% of the PCB market. Independent or merchant PCB manufacturers accounted for the other half. As is clear from Figure 201.2, captive houses have been shutting down their PCB manufacturing operations and instead purchasing PCBs from the smaller independent manufacturers.

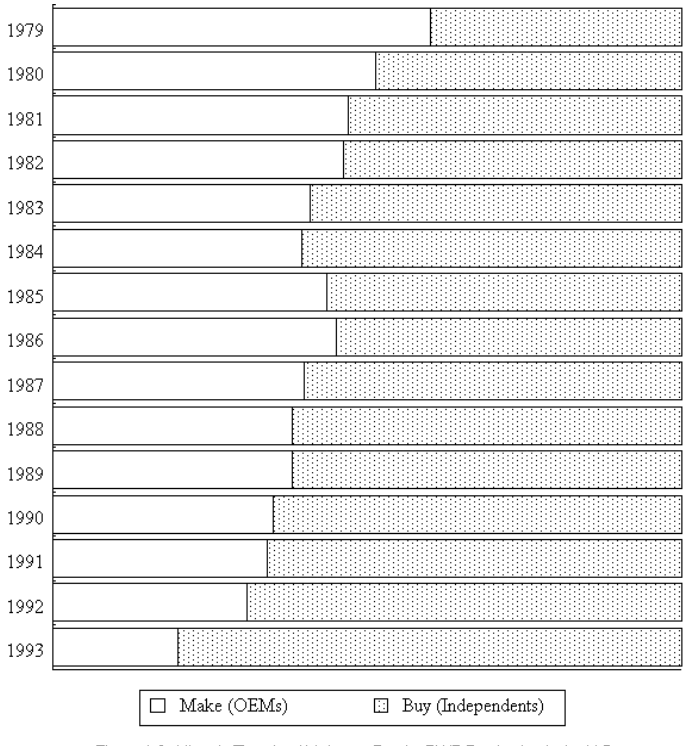


Figure 201.2
Historic Trends of Manufacturing Versus Buying PCBs in the U.S. (by dollar volume).

Source: IPC Technology Marketing Research Council, June 1994

202 PRIMARY CHEMICALS USED

The primary chemicals used include the following:

- Plating chemistries (additive, electroless, electrolytic, etchback/ desmear, oxide);

- Solder mask (dry film, photoimagible liquid, screen-defined);
- Etchants (ammoniacal, cupric chloride, peroxide sulfuric, persulfate, ferric chloride);
- Imaging products (dry film, photoimagible liquid, screen defined, resist);
- Imaging chemicals (aqueous and solvent developers and strippers); and
- Other chemicals (fluxes, metal strippers, cleaners, anti-tarnish, waste treatment chemistries).

203 OVERVIEW OF MANUFACTURING METHODS

PCBs are produced using either additive or subtractive technology. The subtractive process accounts for a significant majority, perhaps 80 percent, of PCB manufacturing.

203.1 SUBTRACTIVE MANUFACTURING

Subtractive Process

The conventional subtractive manufacturing process begins with a board, consisting of epoxy resin and fiberglass, onto which patterns are imaged. In most operations, conducting material, usually copper, is bonded onto the substrate surface to form copper-clad laminate. After drilling holes through the laminate and making those holes conductive, unwanted copper is etched off, leaving copper patterns.

As shown in Figure 203.1, the subtractive process begins with copper-clad laminate, composed of a thin copper foil covering both sides of the epoxy-glass core material (a). The laminate is coated with a sacrificial photopolymer material that acts as a resist in subsequent steps (b). The resist is photoimaged (exposed/developed) to expose the copper to be removed (c). The board is then etched, after which the resist material is stripped and disposed in a fabrication waste stream, leaving the desired interconnect pattern in copper on the exposed laminate (d).

In a multilayer structure, each of the inner layers is constructed independently, then laminated together using a B-stage epoxy in between each inner layer core to form the overall structure (e). This non-sequential process of building multilayers is essentially independent of the number of inner layers laminated together and is used to build PCB structures with independent of the number of

inner layers laminated together and is used to build PCB structures with any number of layers.

203.2 ADDITIVE MANUFACTURING

Capital Intensive

Additive technology is used less often than substractive technology because it is a more difficult and costly production process. This capital-intensive technology is used primarily for small interconnection components used in multi-chip devices.

As shown in Figure 203.2, the additive process for rigid boards begins with a bare catalyzed laminate with no metal on the surfaces (a). Alternatively, with some processes, the first layers on either side of the core laminate are etched to form power and ground planes and may already have plated through-holes. The laminate is coated with a permanent photodielectric material that acts as the dielectric separating the metal layers (b), thus replacing the subsequent core and B-stage layers in the subtractive approach. The dielectric is imaged and developed to form the vias, then a second layer is applied to form the interconnect pattern (c). The board is then selectively plated or metallized by other means, forming the desired interconnect pattern (d). In a multilayer structure, steps (b), (c), and (d) are repeated to form the overall structure (e). In contrast to the conventional subtractive process described previously, this process requires no lamination, with the unreinforced layers built sequentially on the initial rigid core.

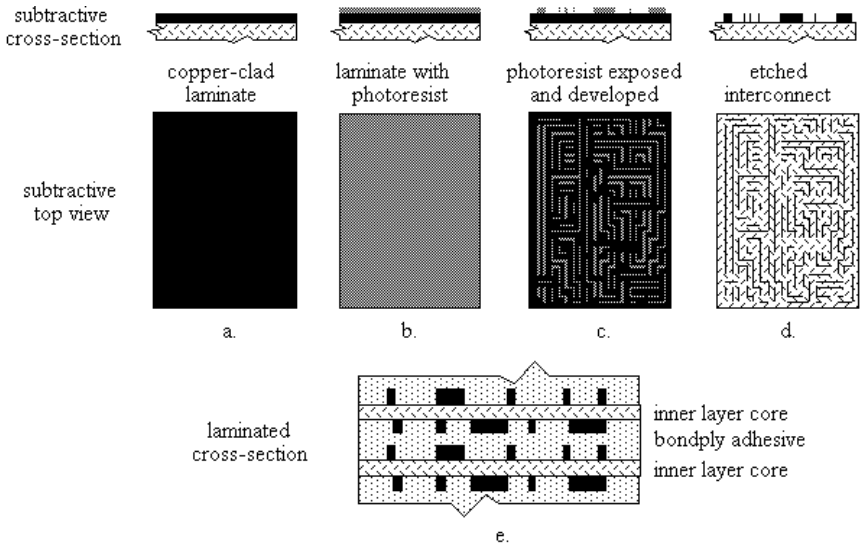


Figure 203.1
Simplified Subtractive Process for Manufacturing Inner Layers of Rigid Multilayers (a through d), and a Cross-Section of Two Inner-Layer Cores within a Multilayer Structure (e).

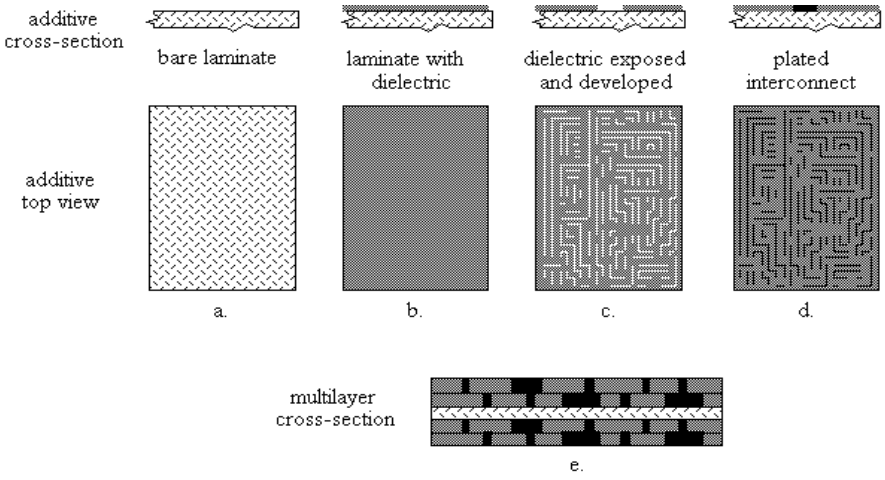


Figure 203.2
Simplified Additive Process for Manufacturing Inner Layers of Rigid Multilayers (a through d), and a Cross-Section of Two Inner-Layer Cores within a Multilayer Structure (e).

204 OVERVIEW OF PCB TYPES

Three Types of PCBs

A PCB consists of a nonconducting substrate (typically fiberglass with epoxy resin) upon which a conductive pattern or circuitry is formed. Copper is the most prevalent conductor, although nickel, silver, tin, tin-lead, and gold may also be used as etch-resists or top-level metal. There are three types of PCBs: single-sided, double-sided, and multilayer.

Single-sided boards have a conductive pattern on one side only, double-sided boards have conductive patterns on both faces, and multilayer boards consist of alternating layers of conductor and insulating material bonded together. The conductive layers are connected by plated through-holes, which are also used to mount and electrically connect components. PCBs may also be either rigid, flexible, or a combination of the two (rigid-flex).

204.1 SINGLE-SIDED PCB

Single-sided Manufacturing

Several critical manufacturing steps are not included in the typical single-sided manufacturing sequence and no process is unique to single-sided production. Therefore, any manufacturer of double-sided or multilayer PCBs can produce single-sided ones as well. Few shops produce single-sided panels exclusively, but instead include single-sided panels as part of their overall product mix. The most common sequence of single-sided production is drill, print-and-etch, surface finish, and final fabrication (all of these production processes are explained in Section 203). No inner-layer processing is required, and desmear is also eliminated. Furthermore, only in rare cases are plated through-holes required; therefore, all of the processes required to make the holes conductive are not applicable to single-sided manufactures. The holes instead provide mechanical stability for through-hole panels. Drilling may be completely eliminated on single-sided PCBs if the components are all surface-mounted.

204.2 DOUBLE-SIDED PCB

Double-sided Manufacturing

Not unlike single-sided, double-sided PCB manufacturing is also a subset of the multilayer process. The inner layer image transfer, lamination, and hole cleaning process are not performed. Therefore, any multilayer manufacturer can easily produce double-sided panels. Double-sided PCBs require electroless copper or other methods of making holes conductive, since the top and bottom sides of the board require interconnection.

204.3 MULTILAYER PCB

Single- and double-sided manufacturing processes are subsets of the multilayer process. Therefore the multilayer manufacturing process will be described in detail in Section 205. Multilayer boards represent two-thirds of the overall value of U.S. production dollars, even though they are produced in lower numbers than single- or double-sided PCBs. The rigid multilayer process (rigid PCBs) represent about 95% of U.S. production.

204.4 FLEXIBLE PCB

Flexible Circuit Manufacturing

A flexible circuit is manufactured on materials that allow for the bending or flexing of the PCB to create a three-dimensional effect. Flex circuits may be designed to be bent into shape once or several times, or to withstand thousands of flexing cycles. They are found in printers, disk drives, automobile electronics, and a wide range of other common products.

Although similar to rigid manufacturing in many respects, the flexible circuit manufacturing process deals with unique materials and surface finishes. Therefore, few rigid manufacturers have expanded into the flex market. On the other hand, because an important portion of the flex market is rigid-flex combination of assemblies, manufacturers of predominantly flex PCBs often produce rigid boards as well. Because flexible substrates are more difficult to manufacture, they are less common than rigid multilayer PCBs.

Image transfer, drilling, and through-hole plating are performed in a similar, but not identical manner. Flex substrates are thin and are unlike standard rigid materials. Some common flex materials are polyamide and polyester, although many others are in use. Thickness of only a few mils (thousandths of an inch) are common compared with inner-layer rigid material thickness of up to 31 mils, and double-sided thicknesses of 62 or more mils. Additionally, tooling and surface finish processes for flexible circuits are quite different from those of rigid PCBs. A cover sheet of material similar to the base film is applied over typical flex circuitry rather than solder mask and is press laminated over the circuitry. The cover sheet is pre-punched to expose appropriate areas of the circuit for soldering of components and connectors. Not all flex circuits require solder; those that do are hot-air or hot-oil solder-coated. Nickel-gold is also a common finish.

205 PROCESS DESCRIPTION OF MULTI-LAYER PCB MANUFACTURING

Multilayer Printed Circuit Board Manufacturing Operation

The manufacturing of printed circuit boards requires numerous steps to produce the final product. These processes may be electrical, chemical, mechanical, or optical in nature. Although printed circuit boards may be either single-layer or multi-layer, the most sophisticated facilities are capable of producing multilayer boards. Therefore, this section will describe multilayer printed circuit board operations. Typical processing steps encountered at PCB manufacturing facilities are discussed in this section. Section 209.1 contains a process flow diagram for a typical multilayer printed circuit board manufacturing operation.

205.1 INNER LAYER CIRCUIT FORMATION

Cores

Multilayer printed circuit boards contain several individual inner layers. These inner layers are thin fiberglass epoxy sheets or "cores," with detailed circuit patterns on each core. This section describes the processes required to form the circuit patterns on an inner layer core.

205.1.1 Core Preparation Steps

The raw materials are thin fiberglass epoxy cores covered with copper foil on each side. The cores are often processed through several surface preparation steps to promote adhesion of a resist coating to the core. These surface preparation steps may include subjecting the cores to weak acid solutions, pumice scrubs or aluminum oxide, and water rinses which clean and lightly abrade the copper foil surfaces. The cores may then be dried in ovens before proceeding to the next step.

205.1.2 Resist Application Operations

Resists contain photosensitive organic monomers and other volatile organic compounds. Upon exposure to ultraviolet light, the photosensitive organic monomers will polymerize and harden. There are two types of resist in use today: dry film resists and liquid resists:

Dry Film Resist

- Dry film resist comes in large rolls containing a thin film of resist covered by a protective mylar film. Laminators use heat and pressure

to apply the dry film resist to both sides of the core material simultaneously.

- Liquid resists may be applied to the entire core surface (one side at a time or both sides at the same time) or just to certain areas of the core surface. There are a number of application techniques including: squeegees, rollers, sprays, and silk screens. After application of liquid resist, the coated cores are usually tack dried in ovens.

Liquid Resists

205.1.3 Exposure Units

Selectively Exposing Certain Areas

The photosensitive nature of resists enable printed circuit board manufacturers to define the precise location of the circuit pathways on the core surface by selectively exposing certain areas of the resist to ultraviolet (UV) light. This selective exposure is accomplished with photo design tools and electrically powered image units. Organic monomers in the exposed areas polymerize and harden while the resist that was not exposed to the UV light remains soft. For the positive photoresist process, the desired circuit trace pattern is exposed to the UV light. For inner layer circuit formation, most PCB facilities use a positive photoresist process.

205.1.4 Developers

Potassium Carbonate

After the circuit design has been exposed on the resist covered cores, the cores are sent to the Develop, Etch, Strip (DES) lines to reveal the final circuit pattern. The developer is typically a series of baths equipped with a conveyor. The first bath normally contains an aqueous solution of potassium carbonate and the remaining baths are water rinses. The soft unpolymerized resist is dissolved by the potassium carbonate solution, revealing the underlying copper foil.

205.1.5 Etchers

Copper Foil is Removed

This copper foil is then removed at the Etcher. The remaining polymerized resist protects the desired copper circuit traces during the etching process. Most inner layer etchers use either cupric chloride solutions or ammoniacal/alkaline solutions to remove the unwanted copper foil.

205.1.6 Resist Strippers

Aqueous or Semi-aqueous Solutions

The stripping step removes the hard polymerized resist from the remaining copper foil circuit pattern. Resist strippers use aqueous solutions of water miscible organic compounds to soften and dissolve the polymerized resist. These strippers can be operated continuously using enclosed conveyorized equipment, or in batch mode using dip tanks that are covered when not in use. The stripping solution may be classified as either aqueous for solutions with low percentages of organic compounds, or semi-aqueous for solutions with higher percentages of organic compounds.

205.1.7 Oxide Line

Surface Preparation Step

After resist stripping, the cores are processed at an Oxide Line to prepare the copper surfaces for panel assembly and lamination. The Oxide Line consists of a series of baths. The first baths use inorganic solutions to clean and micro-etch the remaining copper on the cores. The next baths add an oxide layer to the surface of the copper. Typically this oxide layer is cupric oxide, which is black; but other oxides such as white tin oxide may be added. The oxidation process is considered to be a surface preparation step.

206 PANEL ASSEMBLY

The inner layer cores must be assembled together to form a multilayer printed circuit board panel. This section discusses the equipment and procedures used to assemble a panel and prepare it for outer layer circuit formation.

206.1 LAMINATION PRESS

Book

A “book” is created by placing: a layer of copper foil, a layer of “pre-preg” (a sheet of epoxy material), alternating layers of the inner layer cores and pre-preg, and a final layer of copper foil, between press plates. The book layers are joined together at a Lamination Press by subjecting the "book" to high heat and pressure. The pre-preg melts, joining the layers together and forming a rigid panel.

206.2 PANEL CURING OVENS

After lamination, the rigid panel may be heat cured in an oven. These ovens are usually electrically powered.

206.3 PANEL TRIMMING AND DRILLING

Cleaned of Excess Pre-Preg

The circuit board panel edges may be cleaned of excess pre-preg, shaped, and smoothed by routers, saws, and buffers. In addition, small holes are drilled through the panels to join the individual layers together.

206.4 DRILL HOLE CLEANING (DESMEAR)

Drill Smear

The hole surfaces must be cleaned, made conductive, and then plated to form a complete circuit through the entire panel. The drilling process leaves an epoxy residue, or "drill smear," in the holes which must be removed before copper can be electroless plated in the drill holes. Removing this drill smear, or desmearing, is accomplished by either wet chemical methods or by a gaseous plasma process.

206.4.1 Wet Chemical Methods

Permanganate Bath

The wet chemical methods typically include an organic/water conditioner bath to soften the pre-preg residue, a permanganate bath to dissolve the softened epoxy, a dilute hydrogen peroxide solution to neutralize the permanganate, and several water rinse steps.

206.4.2 Plasma Process

Ionized Gas

The plasma process uses ionized gas under vacuum to chemically react with the drill smear and etch the hole surfaces. The gas components, processing time, temperature, pressure, and RF power level are used to control the reaction. The gas components and reaction products can vary considerably from one operation to another.

206.5 MAKING HOLES CONDUCTIVE

After cleaning the drill holes, the holes must be made conductive so that they may be electroplated. There are several methods currently available to make the drill holes conductive.

206.5.1 Metalization by Electroless Copper Plating

Formaldehyde

Metalization of the drill holes is accomplished by electroless copper plating. The plating baths consist of water, metal ions, catalyst, reducer, complexing agents, and stabilizers. Formaldehyde is sometimes used as a reducing agent in electroless copper plating solutions.

206.5.2 Alternative Metalization Processes

Alternative metalization processes such as “shadow,” “crimson,” or “black hole” add other types of conductive materials, such as graphite, to the hole surfaces.

206.6 PANEL PREPARATION

In order to prepare the panels to receive photo resist on the outer layers of the panel, the panels are subjected to antioxidant baths, cleaners, and pumice scrubs similar to the Core Preparation step discussed in Section 205.1.1 above. Some facilities also add an anti-tarnish coating at this step.

207 OUTER LAYER CIRCUIT FORMATION

This section describes the processes used to create the printed circuit design on the two outer layers of the panel.

207.1 RESIST APPLICATION OPERATIONS

Outer Layer Circuit Formation

The types of resist and application methods used by the PCB industry for Outer Layer Circuit Formation are the same as the Resist Application Operations discussed above in Section 205.1.2 for Inner Layer Circuit Formation.

207.2 EXPOSURE UNITS

The resist that has been applied to the outer layers of a circuit board panel is selectively exposed to UV light using photo design tools and electric Exposure Units similar to those discussed in Section 205.1.3. for inner layer circuit formation. However, the outer layer circuits are normally produced using a negative photoresist process. In a negative photoresist process, the resist covering the desired circuit traces remains soft because it is not exposed to the UV light, while the resist covering the undesired copper areas is exposed to the UV light and polymerized.

207.3 DEVELOPER

The unexposed resist is removed by a Developer to reveal the copper foil circuit pattern. As described in Section 205.1.4, this developer normally contains potassium carbonate to dissolve the soft unpolymerized resist.

Potassium Carbonate

207.4 ELECTROLYTIC COPPER PLATING LINES

Additional copper is added to the copper foil circuit pattern by electrolytic copper plating. The electrolytic copper plating line includes several cleaning or etching baths, rinses, and a copper sulfate plating bath.

Copper Sulfate Plating Bath

207.5 TIN AND TIN/LEAD PLATING LINES

The new copper circuit design is protected from subsequent processing steps by adding a second layer of metal. Most PCB facilities use tin or tin/lead alloy for this step. The tin or tin/lead alloy is added to the plating line which may include cleaning baths, etching baths, rinses, and electrolytic plating baths.

Electrolytic Plating Bath

207.6 RESIST STRIPPERS

Resist Strippers similar to those discussed in Section 205.1.6 are used to dissolve and remove the polymerized resist to reveal the unwanted copper foil.

207.7 ETCHERS

As described in Section 205.1.5, unwanted copper foil is removed by ammoniacal etchers.

Ammoniacal Etchers

207.8 TIN AND TIN/LEAD STRIPPERS

Inorganic Solvents

The protective layer of tin (or tin/lead) is removed from the copper circuits using either a chemical stripping process or an electrolytic stripping process. Both processes normally use inorganic solutions. Occasionally this step is skipped per customer requirements, and the tin/lead plate is left on the panel for reflow.

208 MISCELLANEOUS OPERATIONS

This section discusses the miscellaneous processing steps that are required to finish the printed circuit board for shipment, alternative technologies, and ancillary operations. These operations may not be found at all PCB facilities.

208.1 SOLDER MASK

LPI Solder Mask

A coating called “solder mask” is applied to the panels to protect all areas of the board except holes and pads that need solder or tips that require gold plating.

Some facilities use wet solder masks, which are applied by silk screen, tack dried in ovens, and UV cured. Most PCB facilities now use a liquid photoimageable (LPI) type solder mask. The LPI masks are uncured monomers with low percentages of volatile organic compounds. LPI masks are applied to the entire panel using many application methods including: squeegees, rollers, or sprays applied to one side of the panel at a time or to both sides at the same time. After application, the LPI mask is tack dried in ovens. The LPI solder masks are exposed to UV light and developed using equipment described in Sections 205.1.3 and 205.1.4.

208.2 SOLDER APPLICATION

Plate, Flux, and Reflow

Solder may be applied to the holes and pads where components will be attached to the boards. The older technology involves a three step process: plate, flux, and reflow. The tin/lead plating process was discussed in Section 207.5. Next, the panels are sent to a fluxer which lightly oxidizes the solder plate surface to prepare it for reflow. Flux can be applied using manual methods or convey-orized rollers or dip tanks. The tin/lead plate is melted in place on the panel during the reflow process, where panels are immersed in reflow oils and heated

to about 425 °F. The heat burns off residual flux and melts the solder. The flux and reflow operations may be contained in a single piece of equipment.

208.3 HOT AIR LEVELING (HAL)

Hot Air Leveling (HAL) is an alternative means of applying solder to a printed circuit board panel. Panels are normally pre-cleaned using conveyorized equipment and aqueous inorganic solutions. Fluxes are applied by manual or conveyorized methods to aid the solder coating process. Solder is coated on the panel by immersing the panel in a hot solder pot (~ 480 °F). Excess solder is removed by hot air knives as the panel exits the solder pot. Panels are often cleaned again, usually with hot deionized water and/or nonionic detergent, or possibly a solvent cleaner.

208.4 LEGEND STENCILING

Legends and other identifiers are printed on the circuit boards using coatings and stencils.

208.5 GOLD PLATING

Electrolytic Gold Plating Bath

Some PCB facilities apply gold to panel tips using an electrolytic gold plating bath.

208.6 MISCELLANEOUS COATING OPERATIONS

Various types of protective coatings may be used in place of solder masking or may be added to the printed circuit boards before shipping.

208.7 SOLDER MASK STRIPPING

Dip Tank

Occasionally, printed circuit board manufacturers will need to remove the solder mask after it has been applied to correct errors. The solder mask is normally stripped from the boards in a dip tank.

208.8 SCREEN AND STENCIL MANUFACTURE AND CLEANING

Legend Stencils

The screens used for liquid resist applications or wet solder mask applications

and stencils used for legend coating are often manufactured on site. Most screens and legend stencils are made from a type of dry photoimageable film. The film is cut to size and exposed to UV light to define the stencil or screen image. The rigid mesh screens that will hold the stencil image design are sprayed with a solution to prepare them to receive the stencil. The stencils are then laid on the screens and hand pressed to dry them. A hot water and peroxide solution is used to develop the stencil by stripping away all unexposed film.

After use, the mesh screens are normally cleaned with bleach to dissolve the stencils. Some facilities also use a citrus type cleaner.

208.9 SOLVENT CLEANING OPERATIONS

Organic Solvents

Organic solvents may be used for wipe cleaning the printed circuit boards, work areas, or to clean processing equipment such as stripper tanks or organic coating application equipment. Solvent dip tanks or vapor cleaners may also be used at PCB facilities.

208.10 TEST EQUIPMENT

Ionic Test Equipment

Most PCB facilities use ionic test equipment, which may contain isopropyl alcohol, for quality control and assurance.

208.11 LIQUID STORAGE EQUIPMENT

PCB facilities have various sizes of storage vessels for the chemicals and solutions they use to produce printed circuit boards and for the waste products they generate during processing.

208.12 WASTE TREATMENT OPERATIONS

Most of the waste treatment operations involve metals removal by precipitation and filtering and neutralization of waste water.

209 PROCESS FLOW DIAGRAM

Figure 209.1 illustrates one example of a process flow diagram for a multi-layer printed circuit board manufacturing operation. Variations in the type and order of these processes are possible.

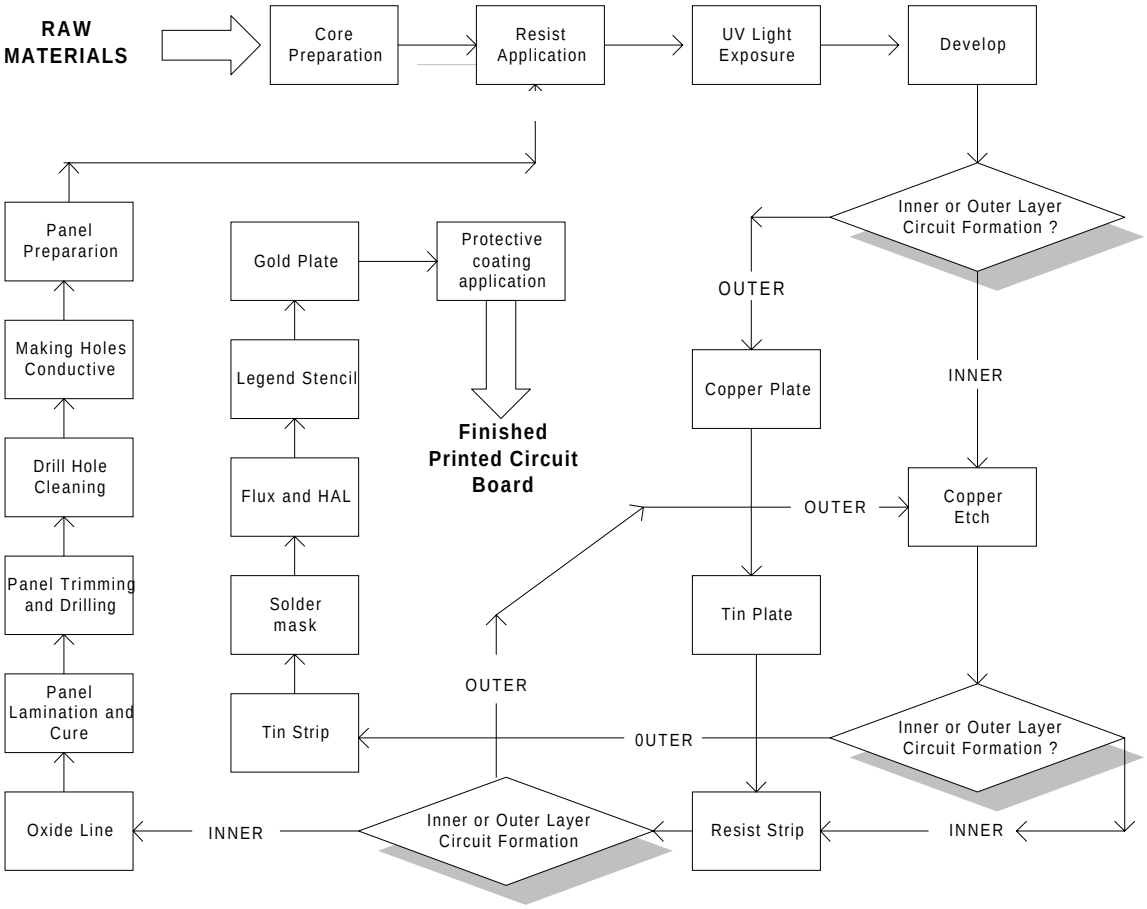


Figure 209.1
PCB Process Flow Diagram

Toxic Air Contaminant

A toxic air contaminant (TAC) is defined as an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health. In California, TACs have been identified under the process stipulated in Assembly Bill (AB) 1807 (Health and Safety Code Sections 39650 et. seq., Food and Agriculture Code Sections 14021 et seq.). Under this process, the ARB and the Office of Environmental Health Hazard Assessment develop a comprehensive report on the health risk associated with a compound or element. After public review and comment, the report is then submitted to the Scientific Review Panel, a group of experts in various scientific fields.

Control Measures

The final decision regarding the listing of a candidate substance is made by the ARB at a public hearing. After identification as a toxic air contaminant, the control phase begins. During this phase, sources of TACs are evaluated to determine the necessity for controls. If found appropriate, control measures are developed by staff and are submitted to the ARB to be considered for adoption into the California Code of Regulations. At the beginning of 1993, there were 18 substances which had been identified by the ARB as TACs and incorporated into Title 17 of the California Code of Regulations, Section 93000.

Hazardous Air Pollutants

However, this list was greatly expanded in 1993. With the signing into law of AB 2728 in 1992, substantial changes to the TAC Program were enacted. AB 2728 required specific actions to be taken by the ARB to achieve greater uniformity between the California and the federal air toxics program. Assembly Bill 2728 specified that the ARB must, by regulation, identify as TACs the 189 substances the federal government had listed as hazardous air pollutants (HAPs) in the Clean Air Act Amendments (CAAA) of 1990. These 189 substances included, in some fashion, the 18 substances already identified by the ARB.

Clean Air Act Amendments (CAAA) of 1990

As a consequence of 1990 CAAA, the federal Environmental Protection Agency (federal EPA) published in the Federal Register in July 16, 1992, an initial list of 166 categories of major sources and 7 categories of area sources that emitted HAPs. One category of area sources (commercial dry cleaning) was divided into two subcategories, transfer machines and dry to dry machines.

Major Source

According to the CAAA, a major source is any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit 10 tons per year of any HAP or 25 tons per year or more of any combination of HAPs. An area source category is any stationary source of HAPs that is not a major source, but to be listed the Administrator must also make a finding

that such a category or subcategory presents a threat of adverse effects to human health or the environment. By law the EPA must promulgate a national emission standard for all of these categories and subcategories by November 15, 2000. All major sources of HAPs are also required to have a Title V operating permit issued by any local California air district to which the NESHAP applies. Area sources of HAPs may be required to have a Title V operating permit, or they may be deferred or exempted from this requirement.

National Emissions Standards for Hazardous Air Pollutants

If it is not feasible for the EPA Administrator to prescribe or enforce an emission standard (e.g. mg/m^3, ppm, g/process rate) for control of a HAP, the Administrator may, in lieu thereof, or in addition to, promulgate a design, equipment, work practice, operational, or combination standard. Federal toxic control standards are identified by the acronym NESHAPs (national emissions standards for hazardous air pollutants) or, at times, for standards promulgated after 1990, MACTS (maximum achievable control technology standard). California's air toxic control measures are called ATCMs (air toxic control measures).

A listing of the 189 federal HAPs, including the 18 substances previously listed by the ARB as TACs in California, is presented in Appendix A. They are not listed here in this text only because of the length of the list. The 18 substances shown in Table 300.1 have undergone the comprehensive health risk assessments by the ARB, as required by the AB 1807 process. Substances that have been classified as HAPs and that are being used in the printed circuit board industry are listed in Table 300.2.

300.1 MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT) STANDARDS

U.S. EPA is authorized to establish Maximum Achievable Control Technology (MACT) standards for source categories that emit a least one of the pollutants on the HAPs list.

In addition, U.S. EPA is in the process of identifying categories of industrial facilities that emit substantial quantities of any of the 189 HAPs. U.S. EPA is in the process of developing regulations that will apply specifically to the semiconductor industry. These standards, which will require the maximum degree of pollution reduction, can be

imposed on listed sources and may require a wide range of control measures, including:

- Installation of control equipment;
- Process changes;
- Material substitution;
- Work practice changes; and
- Operator training or certification.

These measures are expected to achieve 75- to 90-percent emission reduction below current levels.

There is not yet a scheduled MACT standard for the printed circuit board industry. A source will receive a 6-year extension in the compliance date for a MACT standard if it achieves 90 percent reduction in its air toxic emissions prior to the date on which the MACT standard is proposed for its industry category. There is no requirement to notify EPA before issuance of the standard; however, the demonstration of emissions reduction must be made before the standard is proposed.

Table 300.1
TACs Researched and Identified by ARB

Asbestos	Benzene	Cadmium
Carbon Tetrachloride	Chloroform	Chromium VI
Chlorinated Dioxins	Ethylene Dibromide	Ethylene Dichloride
Ethylene Oxide	Formaldehyde	Inorganic Arsenic
Methylene Chloride	Trichloroethylene	Vinyl Chloride
Nickel and Compounds	1,3-Butadiene	Perchloroethylene

Table 300.2
Printed Circuit Industry HAPs

Ammonia	Chlorine	Dimethyl formamide
Formaldehyde	Hydrochloric acid	Lead compounds
Methanol	Nickel compounds	

301 AMMONIA

Extremely Pungent Odor

Ammonia is a colorless, corrosive, alkaline gas with an extremely pungent odor. It can be liquefied by compression and will attack some forms of plastics, rubber, and coatings (HSDB, 1991). The liquid produces low temperatures by its own evaporation. Ammonia is very soluble in water, ether and chloroform, and moderately soluble in alcohol. Ammonia is a good solvent (Merck, 1989). See Table 301.1 for physical properties of ammonia compounds.

Table 301.1
Physical Properties of Ammonia

Synonyms: anhydrous ammonia; ammonia gas; spirit of hartshorn; Am-Fol; Nitro-Sil

Molecular Weight:	17.03
Boiling Point:	-33.35 °C
Melting Point:	-77.7 °C
Vapor Density:	0.6 (air = 1)
Vapor Pressure:	10 atm at 25.7 °C
Density/Specific Gravity:	0.7710 g/l (water = 1)
Heat of Vaporization:	5.581 kcal/mole
Critical Temperature/Pressure:	132.4 °C/111.5 atm
Conversion Factor:	1 ppm = 0.70 mg/m^3

(HSDB, 1991; Merck, 1989)

301.1 AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of ammonia.

301.2 ATMOSPHERIC PERSISTENCE

Gas Phase

Ammonia exists in the atmosphere in the gas phase, and is subject to gas-phase reaction with photochemically-produced hydroxyl radicals, wet and dry deposition, and reaction with gaseous nitric acid (to form particulate ammonium nitrate), and with aerosols to form ammonium salts. The gas phase reaction of ammonia with the hydroxyl radical is slow, with a calculated half-life of ammonia due to gas phase reaction with the hydroxyl radical estimated to be about 2 months (Atkinson, 1995).

301.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program. Of the risk assessments reviewed as of December 1996, for non-cancer effects, ammonia contributed to the total hazard index in 15 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1. Ammonia also contributed to the total hazard index in 28 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 1 of these risk assessments (OEHHA, 1996b).

301.4 HEALTH EFFECTS

Inhalation, Ingestion, and Dermal Contact

Probable routes of human exposure to ammonia are inhalation, ingestion, and dermal contact.

Irritating to the Eyes and Respiratory Tract

Non-Cancer: Ammonia is irritating to the eyes and respiratory tract. High concentrations cause conjunctivitis, laryngitis, and pulmonary edema, possibly accompanied by a feeling of suffocation (OSHA, 1989). Persons with asthma may be particularly sensitive to exposure to ammonia.

The National Academy of Sciences has recommended a 1-hour Emergency Exposure Guidance Level (EEGL) of 71 milligrams per cubic meter (mg/m^3) (NRC-EEGL, 1987). The basis for the National Research Council (NRC)-EEGL is severe sensory irritation in human volunteers exposed to 100 mg/m^3.

Toxicological Endpoint Considered for Acute Toxicity is Respiratory Irritation

An acute non-cancer Reference Exposure Level (REL) of 2.1 x 10^3 microgram per cubic meter (ug/m^3) and a chronic non-cancer REL of 100 ug/m^3 for ammonia are listed in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for acute toxicity is respiratory irritation. The toxicological endpoints for chronic toxicity are the respiratory system and skin irritation or other effects (CAPCOA, 1993).

Toxicological Endpoints for Chronic Toxicity are the Respiratory System and Skin Irritation or Other Effects

The United States Environmental Protection Agency (U.S. EPA) Reference Concentration (RfC) of 100 ug/m^3 is based on lack of pulmonary function test changes and respiratory symptoms in occupationally exposed workers compared with control workers. The U.S. EPA estimates that inhalation of this concentration or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1995a).

Cancer: The International Agency for Research on Cancer and the U.S. EPA have not evaluated the carcinogenic potential of ammonia (IARC, 1987a; U.S. EPA, 1995a).

302 CHLORINE

Suffocating and Very Irritating

Chlorine occurs as a greenish-yellow diatomic gas, a liquid, or in rhombic crystals. The odor is suffocating and very irritating upon inhalation. Chlorine is soluble in water, alcohols, and alkalis. It is a powerful oxidizing agent, strongly electronegative, very reactive, and combines readily with all elements except the rare gases (xenon excluded) and nitrogen. Chlorine also acts as an electron-acceptor in forming complexes with many donor species. Monatomic chlorine is unstable under ordinary conditions and can be formed as a result of thermal or optical dissociation, by an electrical discharge, or as an intermediate during chemical reactions. Chlorine is marketed in the form of gas over liquid compressed into steel cylinders (Merck, 1989). Chlorine may be used as an oxidizer for cupric chloride etching or may be generated by a cupric chloride etcher which has been over oxidized by sodium chlorate or hydrogen peroxide. See Table 302.1 for physical properties of chlorine compounds.

Table 302.1
Physical Properties of Chlorine

Synonyms: bertholite; molecular chlorine

Molecular Weight:	70.906
Boiling Point:	-34.6 °C
Melting Point:	-100.98 °C
Vapor Density:	2.5 (air = 1 at boiling point of chlorine)
Density/Specific Gravity:	1.4085 at 20/4 °C
Vapor Pressure:	5 atm at 10.3 °C
Conversion Factor:	1 ppm = 2.9 mg/m^3

(HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

302.1 AMBIENT CONCENTRATIONS

Chlorine is routinely monitored by the statewide Air Resources Board air toxics network. The network's mean concentration of chlorine from January 1996 through December 1996 is estimated to be 1.6 micrograms per cubic meter (ug/m^3) or 0.55 parts per billion (ARB, 1997c). A United States Environmental Protection Agency (U.S. EPA) study reports chlorine concentrations of approximately 0.001 parts per million (ppm) or 2.9 ug/m^3 around coastal areas, and ambient levels in metropolitan areas such as Cincinnati or Baltimore averaging 0.02 ppm or 58 ug/m^3 (HSDB, 1991).

302.2 ATMOSPHERIC PERSISTENCE

Chlorine absorbs in the ultraviolet and visible region of the solar spectrum (260 to 470 nanometers) and undergoes rapid photolysis in the atmosphere. The atmospheric half-life and lifetime of chlorine due to photolysis is estimated to be about 10 minutes and 14 minutes, respectively. The chlorine atoms produced will then react with organic compounds (mainly alkanes in polluted urban areas) to form hydrogen chloride (Atkinson, 1995).

302.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer effects, chlorine contributed to the total hazard index in 9 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1. Chlorine also contributed to the total hazard index in 28 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual acute hazard index greater than 1 in 6 of these risk assessments (OEHHA, 1996b).

302.4 HEALTH EFFECTS

Inhalation, Ingestion, and Dermal Contact

Probable routes of human exposure to chlorine are inhalation, ingestion, and dermal contact (HSDB, 1991).

Irritation of the Eyes, Nose, Throat, Respiratory Tract, and Lungs

Non-Cancer: Chlorine gas is converted to hydrochloric acid (HSDB, 1991). Low level exposure (less than 3 ppm) causes irritation of the eyes, nose, throat, respiratory tract, and lungs. High level exposure (greater than 30 ppm) causes chest pain, vomiting, toxic pneumonitis, pulmonary edema, and death (U.S. EPA, 1994a). High concentrations also act as an asphyxiant by causing cramps in the muscles of the larynx (choking) and swelling of the mucous membranes which lead to suffocation, nausea, vomiting, anxiety, and syncope (Sittig, 1991).

Toxicological Endpoint Considered for Chronic and Acute Toxicity is the Respiratory System

An acute non-cancer Reference Exposure Level (REL) of 23 ug/m^3 and a chronic REL of 7.1 ug/m^3 are listed for chlorine in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for chronic and acute toxicity is the respiratory system (CAPCOA, 1993). The U.S. EPA is currently reviewing toxicity data to derive a Reference Concentration (RfC) and an oral Reference Dose (RfD) for chlorine (U.S. EPA, 1994a).

Limited information is available on adverse developmental or reproductive effects of chlorine in humans or animals via inhalation exposure (U.S. EPA, 1994a).

Cancer: No information is available on human carcinogenicity from the inhalation of chlorine (U.S. EPA, 1994a). The International Agency for Research on Cancer and the U.S. EPA have not classified chlorine for carcinogenicity (IARC, 1987a; U.S. EPA, 1994a).

303 DIMETHYL FORMAMIDE

Dimethyl formamide is a colorless to slightly yellow liquid with a faint amine odor. It is miscible with water and most organic solvents (Merck, 1983). Dimethyl formamide is also combustible.

Dimethyl formamide is used primarily as a solvent for organic compounds where a low rate of evaporation is needed. It is used as a solvent for the formation of acrylic fibers and sheets, electrolytes, in electroplating, films and coatings of other polymeric materials such as polyurethanes (HSDB, 1991). Dimethyl formamide is found in trace amounts in circuit board prepreg and laminate materials. See Table 303.1 for physical properties of dimethyl formamide.

Faint Amine Odor

Table 303.1
Physical Properties of Dimethyl Formamide

Synonyms: n,n-dimethylformamide; DMF; DMFA

Molecular Weight:	73.09
Boiling Point:	153 °C
Melting Point:	-61 °C
Flash Point:	67 °C (153 °F) open cup
Vapor Density:	2.51 (air = 1)
Density/Specific Gravity:	0.9445 at 25/4 °C (water = 1)
Vapor Pressure:	3.7 mm Hg at 25 °C
Log Octanol/Water Partition Coefficient:	-1.01
Conversion Factor:	1 ppm = 2.99 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1983; Sax, 1989)

303.1 AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient concentrations of dimethyl formamide.

Dimethyl formamide was detected in the air of Lowell, Massachusetts, at a concentration of 8 parts per billion (ppb) (HSDB, 1991). Other locations in the Northeastern United States have reported ambient concentrations of dimethyl formamide ranging from less than 0.02 to 13.8 micrograms per cubic meter (ug/m^3) or 0.01 to 4.62 ppb in 1983 with a mean estimated at 9.8 ug/m^3 (3.28 ppb) (U.S. EPA, 1993a).

303.2 ATMOSPHERIC PERSISTENCE

Vapor Phase

Dimethyl formamide is expected to exist almost entirely in the vapor phase in ambient air. Dimethyl formamide is expected to react with photochemically-produced hydroxyl radicals in the atmosphere (Howard, 1990). No information on atmospheric half-life and lifetime was found in the readily-available literature.

303.3 AB 2588 RISK ASSESSMENT INFORMATION

No Health Values

Although dimethyl formamide is reported as being emitted in California from stationary sources, no health values (cancer or non-cancer) are listed in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines for use in risk assessments (CAPCOA, 1993).

303.4 HEALTH EFFECTS

Probable routes of human exposure to dimethyl formamide are inhalation and dermal contact.

Inhalation and Dermal Contact

Non-Cancer: Dimethyl formamide is a potent liver toxicant in humans. Acute overexposure caused liver damage in humans. Symptoms of acute exposure in humans include abdominal pain, nausea, vomiting, jaundice, alcohol intolerance, and rashes. Dermal exposure may result in dermatitis in humans. Damage to the liver, kidneys, and lungs has been observed in animals acutely exposed to dimethyl formamide by inhalation (U.S. EPA, 1994a).

Potent Liver Toxicant in Humans

The United States Environmental Protection Agency (U.S. EPA) has established a Reference Concentration (RfC) of 0.03 milligram per cubic meter (mg/m^3), based on digestive disturbances and liver effects in humans. The U.S. EPA estimates that

inhalation of this concentration or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects. The U.S. EPA has not established an oral Reference Dose (RfD) for dimethyl formamide.

The one available study on adverse reproductive effects of dimethyl formamide in humans that reported an increased rate of spontaneous abortions among exposed pregnant women was complicated by concomitant exposure to a number of additional chemicals. In rats exposed by inhalation, reduced implantation efficiency, decreased mean fetal weight, and increased abortions have been reported. In rabbits, exposed by gavage, decreased mean fetal weight and increased percentage of malformed live fetuses per litter and increased percentage of litters with malformed fetuses were observed in the high-dose group (U.S. EPA, 1994a).

Cancer: An increase in testicular germ-cell tumors, and cancers of the pharynx or buccal cavity were reported in workers exposed to dimethyl formamide. The U.S. EPA has not classified dimethyl formamide with respect to its carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer (IARC) has classified dimethyl formamide in Group 2B: Possible human carcinogen based upon limited human evidence (IARC, 1989b).

Possible Human Carcinogen Based Upon Limited Human Evidence

304 FORMALDEHYDE

Formaldehyde is a colorless gas at room temperature and the liquid is clear or water-white. The odor is irritating and pungent. Formaldehyde is very soluble in water and up to 55 percent soluble in ether, acetone, benzene, and alcohol. It is very reactive, combines with many substances, and polymerizes easily (Merck, 1989). It reacts violently with perchloric acid, aniline, performic acid, nitromethane magnesium carbonate, and hydrogen peroxide. Aqueous formaldehyde is corrosive to carbon steel but is not corrosive in the vapor phase. It is not sold commercially because of its tendency to polymerize, but is sold as aqueous solutions (formalin) containing 37 to 50 percent formaldehyde (Sax, 1989; HSDB, 1995). Formaldehyde is found in electroless copper plating solutions and small amounts may be found in some electrolytic copper plating solutions. See Table 304.1 for physical properties of formaldehyde compounds.

Odor is Irritating and Pungent

Table 304.1
Physical Properties of Formaldehyde

Synonyms: methanol; formic aldehyde; oxomethane; oxymethylene; methylene oxide; methyl aldehyde; formalin; formic aldehyde; formal; morbicid

Molecular Weight:	30.03
Boiling Point:	-19.5 °C
Melting Point:	-92.0 °C
Vapor Pressure:	3284 mm Hg at 20 °C
Vapor Density:	1.03 for aq. soln.; 1.08 for gas
Density/Specific Gravity:	1.067 (air = 1)
Log Octanol/Water Partition Coefficient:	0.35
Conversion Factor:	1 ppm = 1.23 mg/m^3

(HSDB, 1995; Merck, 1989; Sax, 1989; U.S. EPA, 1994a)

304.1 AMBIENT CONCENTRATIONS

Formaldehyde is routinely monitored by the statewide ARB toxics monitoring network. The network's mean concentration of formaldehyde from January 1996 through December 1996 is estimated to be 4.15 micrograms per cubic meter (ug/m^3) or 3.37 parts per billion (ppb) (ARB, 1997c). When formaldehyde was formally identified as a toxic air contaminant the ARB estimated a population-weighted annual concentration of 5.4 ug/m^3 or 4.4 ppb (ARB, 1992d).

The United States Environmental Protection Agency (U.S. EPA) has also reported concentrations of formaldehyde from 14 study areas during 1989. Overall range of concentrations from these areas were from 0.53 to 11.0 ug/m^3 or 0.43 to 8.94 ppb with an overall median concentration of 2.6 ug/m^3 or 2.1 ppb (U.S. EPA, 1993a).

304.2 ATMOSPHERIC PERSISTENCE

Photolysis of formaldehyde is calculated to dominate over gas-phase reaction with the hydroxyl radical as a tropospheric removal process, with a photolysis lifetime for formaldehyde of about 4 hours. Formaldehyde is also formed in the atmosphere from the photooxidations of most other organic compounds, and hence it is being removed and formed at the same time (Atkinson, 1995). Rain or fog can shorten the atmospheric lifetime of formaldehyde (ARB, 1992d).

304.3 AB 2588 RISK ASSESSMENT INFORMATION

Cancer Risk Equal to or Greater than 10 in 1 million

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of April 1996, formaldehyde was the major contributor to the overall cancer risk in 39 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million, and contributed to the total cancer risk in 297 of these risk assessments. Formaldehyde also was the major contributor to the overall cancer risk in 3 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million, and contributed to the total cancer risk in 82 of these risk assessments (OEHHA,1996a).

For non-cancer health effects, formaldehyde contributed to the total hazard index in 49 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 7 of these risk assessments. Formaldehyde also contributed to the total hazard index in 61 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 4 of these risk assessments (OEHHA, 1996b).

304.4 HEALTH EFFECTS

The most probable route of human exposure to formaldehyde is inhalation.

Vapors are Highly Irritating to the Eye and Respiratory Tract

Non-Cancer: Vapors are highly irritating to the eye and respiratory tract. Acute effects include nausea, headaches, and difficulty breathing. Formaldehyde can also induce or exacerbate asthma. Chronic exposure is associated with respiratory symptoms and eye, nose, and throat irritation. Repeated exposure of skin to the liquid causes irritation and allergic dermatitis (U.S. EPA, 1994a).
An acute non-cancer Reference Exposure Level (REL) of 3.7×10^2 ug/m^3 and a

Toxicological Endpoint Considered for Chronic Toxicity is Irritation of the Respiratory System

chronic non-cancer REL of 3.6 ug/m^3 are listed for formaldehyde in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for chronic toxicity is irritation of the respiratory system (CAPCOA, 1993). The U.S. EPA has not established a Reference Concentration (RfC) for formaldehyde but the oral Reference Dose (RfD) is 0.2 milligram per kilogram per day (mg/kg/d) based on a decrease in body weight gain and effects on the stomach in rats. The U.S. EPA estimates that consumption of this dose or less over a lifetime would not result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

An increased incidence of menstrual disorders and pregnancy problems were observed in women workers using urea-formaldehyde resins. However, possible confounding factors were not evaluated in this study. A study of hospital equipment sterilization workers did not report an association between formaldehyde exposure and spontaneous abortions (U.S. EPA, 1994a). Exposure of experimental animals to formaldehyde does not appear to result in teratogenic or reproductive effects of significance (ARB, 1992d).

Association Between Formaldehyde Exposure and Lung and Nasopharyngeal Cancer

Cancer: According to the U.S. EPA, limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer (U.S. EPA, 1994a). Formaldehyde is carcinogenic in rodents, producing squamous cell carcinomas in the nasal passages of male and female rats and male mice (ARB, 1992d).

The U.S. EPA has classified formaldehyde in Group B1: Probable human carcinogen, with an inhalation unit risk of 1.3×10^{-5} (microgram per cubic meter)$^{-1}$. The U.S. EPA estimates that if an individual were to breathe air containing formaldehyde at 0.08 ug/m^3, over a lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified formaldehyde in Group 2A: Probable human carcinogen based on limited evidence in humans and adequate evidence in animals (IARC, 1987a).

Formaldehyde is a Carcinogen

The State of California has determined under Proposition 65 and AB 1807 that formaldehyde is a carcinogen (CCR, 1996; ARB, 1992d). The inhalation potency factor that has been used as a basis for regulatory action in California is 6×10^{-6} (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 0-1 ug/m^3 of formaldehyde is estimated to be no greater than 6 in 1million (OEHHA, 1994).

305 HYDROCHLORIC ACID

Irritating Pungent Odor

Hydrochloric acid occurs as an aqueous solution or as hydrogen chloride gas (anhydrous hydrochloric acid). Hydrogen chloride gas is a colorless, nonflammable, corrosive gas with an irritating pungent odor. Hydrochloric acid solutions may be clear or colored yellow by traces of iron, chlorines, and organic matter (Merck, 1989). Hydrochloric acid fumes in the air and is soluble in water, alcohol, benzene, methanol, ethanol, and ether. It is incompatible with most metals, alkali, or active metals (Sittig, 1985). Hydrochloric acid is used in cupric chloride etching, plating activators and as equipment cleaner. See Table 305.1 for physical properties of hydrochloric acid compounds.

Table 305.1
Physical Properties of Hydrochloric Acid
(as Hydrogen Chloride Gas)

Synonyms: hydrogen chloride; chlorohydric acid; muriatic acid; hydrochloride

Molecular Weight:	36.46
Boiling Point:	-84.9 ^{o}C
Melting Point:	-114.8 ^{o}C
Vapor Density:	1.268 (air = 1)
Vapor Pressure:	1.00 mm Hg at -150.8 ^{o}C
Conversion Factor:	1 ppm = 1.49 mg/m^3

(HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

305.1 AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of hydrochloric acid.

305.2 ATMOSPHERIC PERSISTENCE

Hydrogen chloride released into the atmosphere as a gas will undergo wet and dry deposition, and will be readily incorporated into cloud, rain, and fog water. The half-life and lifetime will depend on the locality of the release and the occurrence of precipitation events (Atkinson, 1995).

305.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer health effects, hydrochloric acid contributed to the total hazard index in 24 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 3 of these risk assessments. Hydrochloric acid also contributed to the total hazard index in 30 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1 (OEHHA, 1996b).

305.4 HEALTH EFFECTS

Probable routes of human exposure to hydrochloric acid are inhalation and dermal contact.

Non-Cancer: Hydrochloric acid is highly corrosive and irritating to the eyes and respiratory tract. Acute inhalation exposure may cause coughing, hoarseness, inflammation, and ulceration of the respiratory tract, chest pain, and pulmonary edema in humans. Chronic occupational exposure to hydrochloric acid has been reported to cause gastritis, chronic bronchitis, dermatitis, and photosensitization in workers. Long-term exposure to hydrogen chloride at low levels (greater than 5 parts per million) can cause some dental erosion (U.S. EPA, 1994a).

Highly Corrosive and Irritating to the Eyes

An acute non-cancer Reference Exposure Level (REL) of 3,000 micrograms per cubic meter (ug/m^3) and a chronic REL of 7.0 ug/m^3 are listed for hydrochloric acid in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for acute toxicity is respiratory irritation. The respiratory system and skin are the endpoints related to chronic toxicity (CAPCOA, 1993). The United States Environmental Protection Agency (U.S. EPA) has established a Reference Concentration (RfC) for hydrochloric acid of 7.0 ug/m^3 based on hyperplasia of the nasal mucosa, larynx, and trachea in rats. The U.S. EPA estimates that inhalation of this concentration or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects. The U.S. EPA has not set an oral Reference Dose (RfD) (U.S. EPA, 1994a).

No information is available on adverse reproductive or developmental effects of hydrochloric acid in humans. In rats exposed to hydrochloric acid by inhalation,

severe dyspnea, cyanosis, and altered estrus cycles have been reported in dams, and increased fetal mortality and decreased fetal weight have been reported in the offspring (U.S. EPA, 1994a).

Cancer: No information is available on the carcinogenic effects of hydrochloric acid in humans. In one study, no carcinogenic response was observed in rats exposed by inhalation. The U.S. EPA has not classified hydrochloric acid as to its human carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer (IARC) has classified hydrochloric acid in Group 3: Not classifiable as to its potential human carcinogenicity (IARC, 1987a).

306 LEAD

Lead is a bluish-gray, noncombustible metal that occurs naturally in the earth's crust. Lead is malleable, ductile, and resistant to chemical corrosion. Ordinarily, lead exists in combination with organic and inorganic compounds. "Organic lead" refers to lead compounds which contain carbon while "inorganic lead" refers to lead compounds, including elemental lead, which do not contain carbon (ARB, 1997e). Lead is used in tin/led plating solutions and in hot air leveling and soldering operations.

Organic Lead and Inorganic Lead

There are four stable isotopes and two oxidation states, divalent (+2) and tetravalent (+4). The divalent oxidation state predominates (Sax, 1987). Most lead compounds have high melting points and low water solubilities. Lead is soluble in nitric acid, hot concentrated sulfuric acid, and dissolves slowly in water containing a weak acid (HSDB, 1995). Lead is a poor electrical conductor but a good sound and vibration absorber (Sax, 1987). Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants (Sax, 1989). See Table 306.1 for physical properties of lead compounds.

Table 306.1
Physical Properties of Lead

Synonyms: lead flake; lead metal; plumbum; glover; Omaha

Atomic Weight:	207.19
Atomic Number:	82
Boiling Point:	1,740 °C
Melting Point:	327.43 °C
Density/Specific Gravity:	11.34 at 20/4 °C
Vapor Pressure:	1 mm Hg at 973 °C

(HSDB, 1995; Merck, 1989; Sax, 1989; U.S. EPA, 1994a)

306.1 AMBIENT CONCENTRATIONS

ARB Air Toxics Network

Lead compounds are routinely monitored in California by the statewide ARB air toxics network. The networks mean concentration of lead compounds from January 1996 through December 1996 is estimated to be 13.2 nanograms per cubic meter (ng/m^3) (ARB, 1997c).

California is "In Attainment" for Lead

The 1990-91 statewide population-weighted annual average ambient concentration of lead was estimated to be 0.06 micrograms per cubic meter (ug/m^3) (60 ng/m^3) which is approximately 50 times less than the annual average concentration measured in the mid-1970s. California is "in attainment" for lead which means that the state ambient air measurements are at or below the federal and state ambient air quality standards (ARB, 1997e). The state air quality standard is 1.5 ug/m^3 averaged over 30 days. The federal standard is 1.5 ug/m^3 averaged every calendar quarter.

The United States Environmental Protection Agency (U.S. EPA) has also compiled ambient concentration data from several study areas throughout the United States from 1980-91. Information from these data reported an overall range of concentrations for lead of 0.4 to 50.0 ng/m^3 with an overall mean concentration of 9.0 ng/m^3 (U.S. EPA, 1993a).

306.2 ATMOSPHERIC PERSISTENCE

Particle Phase in the Atmosphere

Lead and lead compounds exist in the particle phase in the atmosphere, and hence are subject to wet and dry deposition. The average half-life and lifetime for particles in the atmosphere is estimated to be about 3.5 to 10 days and 5 to 15 days (Balkanski et al., 1993; Atkinson, 1995). After removal from the atmosphere and being deposited on the ground and soil, inorganic lead may be re-entrained in the atmosphere (ARB, 1993e).

306.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment (OEHHA) reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of April 1996, lead and lead compounds were the major contributors to the overall cancer risk in 2 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million, and contributed to the total cancer risk in 165 of these risk assessments. Lead and lead compounds also contributed to the total cancer risk in 54 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million (OEHHA, 1996a).

For non-cancer health effects, lead contributed to the total hazard index in 37 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 2 of these risk assessments. Lead also contributed to the total hazard index in 43 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 12 of these risk assessments (OEHHA, 1996b).

306.4 HEALTH EFFECTS

Probable routes of human exposure to lead are inhalation and ingestion.

Inhalation and Ingestion

Non-Cancer: Lead salts (e.g., lead acetate, lead subacetate) are considered to be forms of inorganic lead. Most significant non-workplace, outdoor air exposure to lead in California is expected to be to inorganic lead particulate. Although different lead species (e.g., lead oxide, lead sulfide, etc.) are absorbed to varying degrees following inhalation, all are capable of causing adverse health effects once they reach sensitive tissues (ARB, 1997e).

Lead Can Adversely Affect the Nervous, Reproductive, Digestive, Cardiovascular, Blood-Forming Systems, and the Kidney

Lead is only slowly excreted by the body. Exposures to small amounts of lead over a long time can slowly accumulate to reach harmful levels. Harmful effects may therefore develop gradually without warning. Short-term exposure to high levels of lead may also cause harm. Lead can adversely affect the nervous, reproductive, digestive, cardiovascular, blood-forming systems, and the kidney. Symptoms of nervous system effects include fatigue and headaches. More serious symptoms include feeling anxious or irritable, and difficulty sleeping or concentrating. Severe symptoms include loss of short-term memory, depression, and confusion. More severe exposures can prove fatal. Lead can also injure the peripheral nerves to cause weakness in the extremities. Children are a sensitive population as they absorb lead more readily and the developing nervous system puts them at increased risk for lead-related harm, including learning disabilities. Effects on the gastrointestinal tract include nausea, constipation, and loss of appetite. Recovery from severe effects on the nervous system or kidneys is not always complete. Other ill effects include hypertension and anemia (ARB, 1997e). The toxicological endpoints considered for chronic toxicity are the kidney, cardiovascular or blood system, immune, reproductive, and central or peripheral nervous systems (CAPCOA, 1993).

The U.S. EPA has not established a Reference Concentration (RfC) or an oral Reference Dose (RfD) for lead (U.S. EPA, 1994a). The OEHHA developed in their report, *Proposed Identification of Inorganic Lead as a Toxic Air Contaminant, Part B, Health Assessment*, a range of air lead exposures on blood lead levels and subsequent neurodevelopmental risks to young children. This range of neurodevelopmental risks along with information on the U.S. EPA Integrated Exposure Uptake Biokinetic model can be used as an alternate approach to account for health effects of lead exposure including air, soil, and water (ARB, 1997e).

In men, adverse reproductive effects include reduced sperm count and abnormal sperm. In women, adverse reproductive effects include reduced fertility. Still-birth, miscarriage, low birth weight, and neurobehavioral deficits may be more likely. The State of California has determined under Proposition 65 that lead is a developmental toxicant and a male and female reproductive toxicant (CCR, 1996).

Cancer: There are several inconclusive epidemiological studies of exposed workers which provided limited evidence of cancers of the kidney, stomach, and respiratory tract. Rodent studies have found increased kidney cancers following the oral administration of lead. The U.S. EPA has classified lead in Group B2: Probable human carcinogen (U.S. EPA, 1994a). The International Agency for Research on Cancer

has classified lead and inorganic lead compounds in Group 2B: Possibly carcinogenic to humans, and organolead in Group 3: Not classifiable (IARC, 1987a).

Lead and Lead Compounds, Lead Acetate, Lead Phosphate, and Lead Subacetate are Carcinogens

The State of California has determined under Proposition 65 that lead and lead compounds, lead acetate, lead phosphate, and lead subacetate are carcinogens (CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 8.0×10^{-5} $(ug/m^3)^{-1}$ for lead acetate and 1.1×10^{-5} $(ug/m^3)^{-1}$ for lead subacetate (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 microgram per cubic meter of lead acetate is estimated to be no greater than 80 in 1 million and 11 in 1 million for lead subacetate (OEHHA, 1994). A cancer potency value of 1.2×10^{-5} $(ug/m^3)^{-1}$ for lead has been established (ARB, 1996a). The oral potency factor that has been used as a basis for regulatory action in California is 2.8×10^{-1} (milligram per kilogram per day)$^{-1}$ for lead acetate and 3.8×10^{-2} (milligram per kilogram per day)$^{-1}$ for lead subacetate (OEHHA, 1994).

307 METHANOL

Alcoholic Odor When Pure, Crude Material May Have a Repulsive Pungent Odor

Methanol is a flammable, colorless, volatile liquid. It is miscible in water, ethanol, ether, benzene, and ketones. Although it has an alcoholic odor when pure, crude material may have a repulsive pungent odor (Merck, 1989). Methanol burns with a non-luminous bluish flame. It is a highly polar substance (Sax, 1987). Methanol is used in some resist stripper, antitarnish and tin plating solutions in very low concentrations. Methanol may be used for screen cleaning and wipe cleaning operations. See Table 307.1 for physical properties of methanol compounds.

Table 307.1
Physical Properties of Methanol

Synonyms: carbinol; methyl alcohol; methyl hydroxide; wood alcohol; wood spirit; methylol; colonial spirit

Molecular Weight:	32.04
Boiling Point:	64.7 °C
Melting Point:	-97.8 °C
Flash Point:	12 °C (54 °F) closed cup
Autoignition Temperature:	878 °F
Vapor Pressure:	92 mm Hg at 20 °C
Density/Specific Gravity:	0.7915 at 20/4 °C (water = 1)
Vapor Density:	1.11 (air = 1)
Log/Octanol Water Partition Coefficient:	-0.77
Conversion Factor:	1 ppm = 1.31 mg/m^3 at 25 °C

(Howard, 1990; Sax, 1989; HSDB, 1991)

307.1 AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of methanol. However, the United States Environmental Protection Agency (U.S. EPA) has compiled ambient air data from several locations in the United States from 1990-91. From these data, the U.S. EPA has calculated a mean ambient concentration of 23.1 micrograms per cubic meter (ug/m^3) or 17.6 parts per billion (U.S. EPA, 1993a).

307.2 ATMOSPHERIC PERSISTENCE

Vapor Phase

Based on its vapor pressure, methanol is expected to exist almost entirely in the vapor phase in the ambient atmosphere. The dominant chemical loss process for methanol is by reaction with the hydroxyl (OH) radical. The calculated half-life and lifetime of methanol due to reaction with the OH radical are 11 days and 15 days, respectively. The product of this reaction is formaldehyde (Atkinson, 1995). Washout due to rain is expected to be significant due to methanol's water solubility. The detection of methanol in thunderstorm water tends to confirm this supposition (Howard, 1990).

307.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer health effects, methanol contributed to the total hazard index in 26 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1. Methanol also contributed to the total hazard index in 4 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1 (OEHHA, 1996b).

307.4 HEALTH EFFECTS

Inhalation, Ingestion, and Dermal Contact

Probable routes of human exposure to methanol are inhalation, ingestion, and dermal contact (Howard, 1990).

Central Nervous System Depressant and Neurotoxicant

Non-Cancer: Methanol is a central nervous system depressant and neurotoxicant. Acute exposure to methanol may result in headache, vomiting, irritation of the nose and throat, dilation of the pupils, feeling of intoxication, loss of muscle coordination, excessive sweating, bronchitis, convulsions, and death. Very high exposures may result in stupor, cramps and visual difficulties such as spotted vision, sensitivity to light, eye tenderness and blindness. Recovery is not always complete and symptoms may recur without additional exposure. Nerve damage may occur causing loss of coordination and blindness. Because methanol is slowly eliminated from the body, repeated exposure to low levels may cause severe symptoms due to accumulation.

A chronic non-cancer Reference Exposure Level (REL) of 620 ug/m^3 is listed for methanol in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for chronic toxicity is the central or peripheral nervous system (CAPCOA, 1993). The Reference Concentration (RfC) for methanol is under review by the U.S. EPA. The oral Reference Dose (RfD) for methanol is 0.5 milligram per kilogram per day based on indications of adverse liver effects and decreased brain weight in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects.

No information is available on adverse reproductive or developmental effects in humans from exposure to methanol. Developmental studies in rats exposed to metha-

nol by inhalation have shown birth defects involving skeletal, cardiac, and urinary system deformities (U.S. EPA, 1994a).

Cancer: No information is available on the carcinogenic effects of methanol in humans or animals. The International Agency for Research on Cancer and the U.S. EPA have not classified methanol for carcinogenicity (IARC, 1987a; U.S. EPA, 1994a).

308 NICKEL AND COMPOUNDS

Odorless, Silvery, Dark Gray Metal

Nickel is an odorless, silvery, dark gray metal which crystallizes with a face-centered cubic structure. It is insoluble in water and ammonia, soluble in dilute nitric acid, and is more resistant to atmospheric and aqueous corrosion than iron and cobalt. Nickel retains a high polish, is highly ductile, and has good thermal and electrical conductivity (Merck, 1989; HSDB, 1995). Nickel is used in nickel plating solutions. See Table 308.1 for physical properties of nickel compounds.

Nickel carbonyl (nickel tetracarbonyl) is a colorless, volatile liquid at room temperature, boiling at 43 °C and it explodes at 60 °C. It is soluble in alcohol, benzene, chloroform, acetone, and carbon tetrachloride (Merck, 1989).

Table 308.1
Physical Characteristics of Nickel

Atomic Weight:	58.71
Atomic Number:	28
Valences:	2 & 3
Boiling Point:	2,730 °C
Melting Point:	1,455 °C
Vapor Pressure:	1 mm at 1,810 °C
Density/Specific Gravity:	8.9

(HSDB, 1995; Merck, 1989; Sax, 1989; U.S. EPA, 1994a)

308.1 AMBIENT CONCENTRATIONS

Nickel compounds are routinely monitored at the statewide ARB air toxics network. When nickel was formally identified as a toxic air contaminant, the ARB estimated a population-weighted annual concentration of 7.3 nanograms per cubic meter (ng/m^3) (ARB, 1991d). The network's mean concentration of nickel compounds from January 1996 through December 1996 is estimated to be 3.6 ng/m^3 (ARB, 1997c).

The United States Environmental Protection Agency (U.S. EPA) has also reported concentrations of nickel from 3 study areas during 1985. The overall range of concentrations from these areas was from 2.0 to 8.7 ng/m^3 with a mean concentration of 3.8 ng/m^3 (U.S. EPA, 1993a).

308.2 ATMOSPHERIC PERSISTENCE

The atmospheric half-life and lifetime of nickel compounds is estimated to be 3.5 to 10 days and 5 to 15 days, respectively (Balkanski et al., 1993). Nickel particulate is removed from the atmosphere by either wet or dry deposition. The nickel associated with atmospheric pollutants is almost always detected in particulate matter. Nickel is continuously transferred among air, water, and soil by natural chemical and physical processes such as weathering, erosion, runoff, precipitation, and stream and river flow (ARB, 1991d).

308.3 AB 2588 RISK ASSESSMENT INFORMATION

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of April 1996, nickel and nickel compounds represented the principal cancer risk driver in 22 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million and contributed to the total cancer risk in 230 of these risk assessments. Nickel and nickel compounds also were the major contributors to the overall cancer risk in 5 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million, and contributed to the total cancer risk in 78 of these risk assessments (OEHHA, 1996a).

For non-cancer health effects, nickel and nickel compounds contributed to the total hazard index in 41 of the approximately 89 risk assessments reporting a total chronic

hazard index greater than 1, and contributed to an individual hazard index greater than 1 in 2 of these risk assessments. Nickel and nickel compounds also contributed to the total hazard index in 50 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 31 of these risk assessments
(OEHHA, 1996b).

308.4 HEALTH EFFECTS

Inhalation, Ingestion, and Dermal Contact

Probable routes of human exposure to nickel are inhalation, ingestion, and dermal contact (U.S. EPA, 1994a).

Non-Cancer: The effects from long-term exposure to nickel include respiratory tract irritation and immune alterations such as dermatitis ("nickel itch") and asthma. Acute exposure to nickel and nickel compound fumes may cause irritation of the respiratory tract, skin, and eyes. A daily requirement of 50 micrograms of nickel has been estimated to be an essential element in human nutrition (U.S. EPA, 1994a). Nickel carbonyl is the most acutely toxic form of nickel. Exposure to nickel carbonyl can cause irritation of the lower respiratory tract and delayed pulmonary edema. It may also injure the liver and central nervous system (Olson, 1994).

An acute Reference Exposure Level (REL) of 1.0 micrograms per cubic meter (ug/m^3) is listed for nickel compounds in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The immune system is the toxicological endpoint considered for acute toxicity. A chronic non-cancer REL of 0.24 ug/m^3 for nickel and nickel compounds is also listed. The toxicological endpoint considered for chronic toxicity is the kidney, respiratory, and immune systems (CAPCOA, 1993). The U.S. EPA has not established a Reference Concentration (RfC) for nickel compounds but has determined an oral Reference Dose (RfD) for nickel (soluble salts) of 0.02 milligram per kilogram per day (mg/kg/d) based on decreased body and organ weights in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

The average daily intake of nickel is approximately 155 nanograms. Although there are insufficient data to assess nickel's effect on reproductive functions in humans, all forms of nickel examined to date in laboratory animals have exhibited adverse effects on male reproductive function. Animal studies also demonstrate that nickel adversely affects spermatogenesis, litter size and pup body weight, however, no teratogenic

effects have been clearly demonstrated for compounds other than nickel carbonyl (ARB, 1991d). The State of California has determined under Proposition 65 that nickel carbonyl is a developmental toxicant (CCR, 1996).

Cancer: Inhalation exposure to nickel refinery dust and nickel subsulfide has been shown to cause nasal and lung cancer in refinery workers. The U.S. EPA has classified nickel refinery dusts and nickel subsulfide in Group A: Human carcinogen with an inhalation unit risk estimate of 2.4×10^{-4} (microgram per cubic meter)$^{-1}$ for nickel refinery dusts, and 4.8×10^{-4} (microgram per cubic meter)$^{-1}$ for nickel subsulfide. The U.S. EPA estimates that if an individual were to breathe air containing nickel refinery dusts at 0.004 ug/m^3, or air containing nickel subsulfide at 0.002 ug/m^3, over a lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer. Nickel carbonyl has been reported to cause lung tumors in animal studies. The U.S. EPA has classified nickel carbonyl in Group B2: Probable human carcinogen (U.S. EPA, 1994a).

The International Agency for Research on Cancer (IARC) reviewed nickel and nickel compounds in 1990 and concluded that there is sufficient evidence in humans for the carcinogenicity of nickel sulfate, and of the combinations of nickel sulfides and oxides encountered in the nickel refining industry; there is inadequate evidence in humans for the carcinogenicity of metallic nickel and nickel alloys; there is sufficient evidence in experimental animals for the carcinogenicity of metallic nickel, nickel monoxides, nickel hydroxides and crystalline nickel sulfides; there is limited evidence in experimental animals for the carcinogenicity of nickel alloys, nickelocene, nickel carbonyl, nickel salts, nickel arsenides, nickel antimonide, nickel selenides, and nickel telluride; and there is inadequate evidence in experimental animals for the carcinogenicity of nickel trioxide, amorphous nickel sulfide and nickel titanate. The IARC concluded that nickel compounds are carcinogenic to humans, classifying them in Group 1: Human carcinogen; and classified metallic nickel in Group 2B: Possible human carcinogen (IARC,1990).

The International Committee on Nickel Carcinogenesis in Man indicated that the epidemiological evidence points to insoluble and soluble nickel compounds as contributing to the cancers seen in occupationally exposed persons. Both insoluble and soluble nickel compounds have produced tumors in animals by a variety of routes, primarily by injection. Both soluble and insoluble nickel compounds are genotoxic in a wide variety of assays. Evidence is available indicating that the Ni^{2+} ion is probably the carcinogenic agent (ICNCM, 1990).

The State of California under Proposition 65 and AB 1807 has determined that nickel and certain nickel compounds (nickel carbonyl, nickel refinery dust from the pyrometallurgical process, nickel subsulfide) are carcinogens (CCR, 1996; ARB, 1991d). The OEHHA staff concluded that based on available enotoxicity and carcinogenicity data and physicochemical properties of nickel compounds, all nickel compounds should be considered potentially carcinogenic to humans by inhalation, and total nickel should be considered when evaluating the risk by inhalation (ARB, 1991d). The inhalation potency factor that has been used as a basis for regulatory action in California is 2.6×10^{-4} (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 ug/m^3 of nickel is estimated to be no greater than 260 in 1 million.

309 ENFORCEMENT PATHWAYS

For a new federal NESHAP, that NESHAP becomes enforceable in California by the US EPA. In addition, under State law, if no ATCM exists in California for the source category covered by the federal NESHAP, the new NESHAP also becomes an ATCM and becomes enforceable as a State regulation by the local air districts--unless local districts adopt and enforce an equally effective or more stringent ATCM. However, that district-amended ATCM would not be federally enforceable unless the US EPA has approved it.

Federal NESHAP

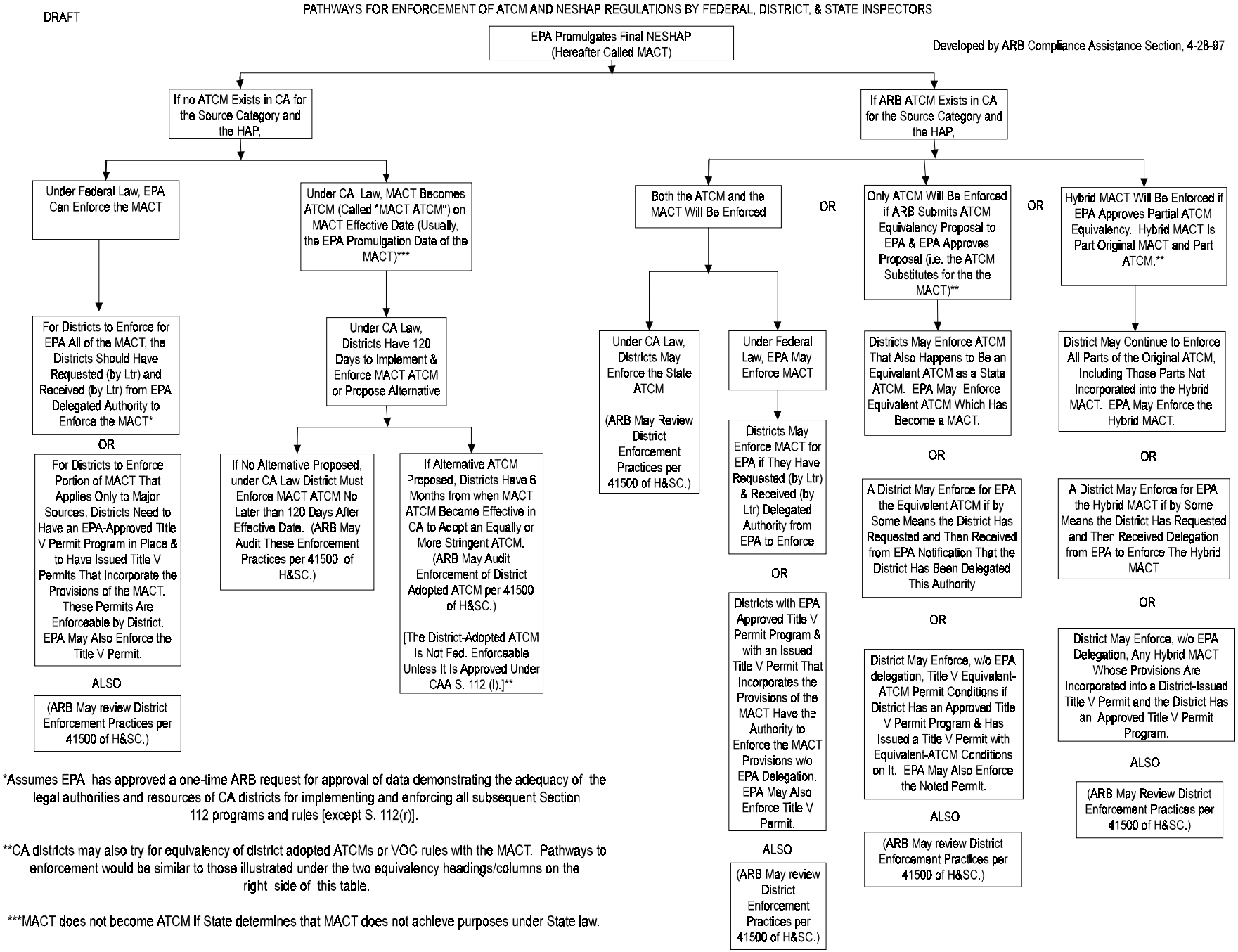
For a new federal NESHAP where an ATCM does exist in California for the source category covered by the federal NESHAP, both regulations are enforceable, the State ATCM by the local air districts and the NESHAP by the EPA. Local air districts may enforce the NESHAP for US EPA if they have been delegated that authority by EPA or if the provisions of the NESHAP have been incorporated into an Title V permit issued by the local air district.

If the State proves to the US EPA that all or a portion of its ATCM is equivalent to all or a portion of the federal NESHAP, the approved portion of the ATCM becomes the NESHAP and is enforceable by both US EPA and the local air districts. For one NESHAP this has occurred: the US EPA has approved California's ATCM for perchloroethylene dry cleaning operations (for area source dry cleaning facilities only) as equivalent to US EPA's NESHAP for area sources in that same source category. A very few major dry cleaning facilities in the State are still subject to the federal NESHAP for perchloroethylene dry cleaning. The EPA may delegate to the local air districts its authority to enforce the ATCM that has become a NESHAP plus any

portion of the NESHAP for which equivalency was not approved. Figure 309.1 illustrates a flow chart of pathways for enforcement of ATCM and NESHAP regulations by federal, district, and state inspections.

The State Air Resources Board, under the State Health and Safety Code, has the authority to review the enforcement practices of the local air districts.

Figure 309.1



*Assumes EPA has approved a one-time ARB request for approval of data demonstrating the adequacy of the legal authorities and resources of CA districts for implementing and enforcing all subsequent Section 112 programs and rules [except S. 112(r)].

**CA districts may also try for equivalency of district adopted ATCMs or VOC rules with the MACT. Pathways to enforcement would be similar to those illustrated under the two equivalency headings/columns on the right side of this table.

***MACT does not become ATCM if State determines that MACT does not achieve purposes under State law.

400 POLLUTION PREVENTION

Aggressive Pollution Prevention Policies

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, reengineering processes to reuse by-products, improving management practices, and employing substitution of chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

Source Reduction

Pollution prevention (sometimes referred to as source reduction) is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water or other resources, and practices that protect natural resources through conservation or more efficient use. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land, and water pollutant releases.

Cost-Effective

Pollution prevention is often cost-effective because it may reduce raw material losses, reduce reliance on expensive "end-of-pipe" treatment technologies and disposal practices, conserve energy, water, chemicals, and other inputs, and reduce the potential liability associated with waste generation. Pollution prevention is environmentally desirable for these very same reasons: pollution itself is reduced at the source while resources are conserved.

401 PCB RAW MATERIALS INPUTS AND POLLUTION OUTPUTS

Outputs from the PCB industry manufacturing processes have the potential to affect the land, air, and water. Table 401.1 describes the wastes generated during the manufacturing process.

Table 401.1
Printed Circuit Board Pollution Outputs

Process	Air Emissions	Process Wastes (Liquids/Waste Waters)	Other Wastes (Solids/RCRA)
Board Preparation	Particulates, acid fumes, and VOCs	Spent acids and spent akaline solutions	Sludge and scrap board material
Electroless Plating		Spent electroless copper baths, spent catalyst solutions, spent acid solutions	Waste rinse water and sludges from waste water treatment
Imaging	Organic vapors and acid fumes	Spent developing solutions, spent resist material, spent etchants, spent acid solutions, and aqueous metals	F006, D002, D008, depending upon process configuration and waste characteristics.
Electroplatingg	Acid fumes, ammonia fumes, and VOCs	D008 (lead), D002, D003, spent etchants, spent acid solutions	F006, F007, and F008
Solder Coating	VOCs		
PCB Assembly And Soldering	VOCs	Metals (nickel, silver, and copper), D008 (lead), flux residue, spent deionized water, spent solvents	Solder dross, scrap boards, filters, gloves, rags, waste water treatment sludge

402 PCB MANUFACTURING AND POLLUTION PREVENTION

Interconnecting and Packaging Electronic Circuits

In the United States, unlike some other areas of the world, the PCB industry has made substantial investments in pollution prevention and control, and is continuing to spend an average of 2.1% and as much as 5% of sales on regulatory compliance and pollution prevention. These investments have paid off with significant pollution prevention successes. For example, the Institute for Interconnecting and Packaging Electronic Circuits (IPC) and several IPC members won EPA Stratospheric Ozone Protection Awards for research on eliminating

ozone-depleting substances PCB manufacturing and assembly. Several IPC members have also won 33/50 Pollution Prevention Awards for their aggressive work on preventing pollution, and many IPC members have won state or local awards for their proactive pollution reduction efforts.

As discussed in Section 200 of this manual, printed circuit boards can be classified into three basic types (single-sided, double-sided, and multi-layered). PCBs consist of patterns of conductive material formed onto a nonconductive base. Commonly used conductor materials include copper, aluminum, chrome, and nickel. The metal conductor is fixed to the base with adhesives and pressure/

Table 402.1
Summary of Selected PCB Pollution Prevention and Recycling Opportunities

Waste Stream	Pollution Prevention and Recycling Opportunities
Solvents and surface preparation (e.g., chemical cleaners, oxidation inhibitors, adhesion promotors)	Use mechanical cleaning instead of solvents Use countercurrent rinsing arrangements to reuse water Recycle cleaning agents and rinse water onsite Explore waste exchange markets Use less toxic cleaners where feasible
Process/plating baths	Use non-cyanide baths Design process carefully Reduce drag-out to extend bath life Implement maintenance techniques to remove impurities Use chemical recovery to recover metals
Etchants	Use thinner copper foil to clad the laminated board Recycle spent etchants
Solder Wastes	Implement solder-free process modifications
Scrap film and packaging	Recyle polyethylene Mylar sheets
Scrap film and resist	Use aqueous resist instead of solvent resist Recyle/reuse photoresist stripper

heat bonding. Base materials include pressed epoxy, paper, phenolic, epoxy glass resins, and teflon-glass. Table 402.1 summarizes selected source reduction and recycling alternatives which are described in the following sections.

Can Decrease Waste Associated with PCB Manufacturing

402.1 PRODUCT CHANGES

New techniques and improvements in the packaging of microchips can decrease waste associated with PCB manufacturing. For example, compared with conventional mounting, surface mount technology allows for closer contact areas of chip leads and reduces the size of PCBs required for given number of packages. The smaller PCB surface area reduces the need for hazardous materials used in cleaning, plating, and photoresist operations; however, the increased density of the circuitry poses new challenges for these and other operations.

402.2 MATERIAL SUBSTITUTION

According to a report prepared by the Alternative Technology Division of the California Department of Toxic Substances Control, there has been nearly a complete switch in the PCB industry toward non-solvent resists.

The Industry has Nearly Eliminated the Use of CFC's

PCB manufacturers have identified and implemented numerous opportunities for material substitution. The major opportunities involve replacing solvent-based products, such as: photoresists used in pattern printing and masking; photopolymer developers, resist solvents, screen inks, conductive adhesives, and inks used in interconnect processes; and cleaners with low- no VOC alternatives. Many of these substitutions must be developed concurrently with other material or process changes. For example, manufacturers and vendors developed a new line of compatible aqueous photodevelopers for use with aqueous photoresists. The industry has nearly eliminated the use of chlorofluorocarbons (CFC's). The industry has also made progress in identifying substitutes for certain acids, formaldehyde, and glycol ethers.

402.3 OFFSITE RECYCLING

PCB wastestreams commonly sent offsite for recycling include sludges for metal recovery, polyethylene and Mylar sheets, film, photoresist stripper, etchants, scrap PCBs and lead components. Additional opportunities may be available for recycling scrap PCBs and lead components.

402.4 PROCESS MODIFICATION

Industry Continues to Implement Alternatives to Wet Chemical Processes

Process modifications to reduce waste generation and environmental impacts apply to almost all stages of the PCB manufacturing process. In general, the industry continues to implement alternatives to wet chemical processes. Process modification opportunities include the following:

- Mechanical cleaning as an alternative to chemical methods.
- Process efficiency improvements for applying photopolymers, printing, and developing.
- Alternative processes for connecting the PCB layers together.
- Alternatives to lead-based soldering involving the use of lasers, reactive gases, or ultrasonics.

402.5 IMPROVED MAINTENANCE TECHNIQUES

Maintaining Plating Baths at Peak Performance Reduces Waste Generation

Maintaining plating baths at peak performance reduces waste generation resulting from product rejects and loss of bath life. As the PCBs move down the plating line, plating solutions adhere to the surface and can contaminate the next tank. Several different process modifications can reduce this problem, which is commonly referred to as drag-out. These techniques, summarized in Table 402.2, are commonly practiced by the PCB industry.

402.6 CHEMICAL RECOVERY TECHNOLOGIES

Some Facilities Recycle their Process Waters Onsite

PCB manufacturers commonly use chemical recovery technologies to reconcentrate plating solutions from rinse water for reuse and purify spent process solutions. Many of the technologies are similar to those used in advanced maintenance. In addition, some facilities recycle their process waters onsite.

Electroplating processes are typically water-intensive. Rinse water reduction techniques reduce the amount of water needed through in-line reuse and recycling. An efficient system includes careful tank design, tight flow controls, and a suitable rinsing configuration.

Table 402.2
Improved Maintenance Techniques

Technique	Description
Plating solution control	Reduce bath viscosity to prevent adherence. Add wetting agents reduce surface tension and minimize drag-out. Prevent the build-up of contaminants in process tanks.
Positioning parts on rack	Position parts on racks to minimize entrapment.
Calibrating withdrawal rates and drainage times	Calibrate withdrawal rates to maximize drainage time before moving the PCBs to the next bath. Use drip shields of boards to capture and return drag-out. Use air knives to enhance drainage.
Rinsing over process tanks	Under certain conditions, install fog or spray rinses over the tanks to spray rinse the PCBs over the plating tanks.
Installing drag-out tanks	Install a drag-out tank. Drag-out tanks are stagnant rinse tanks with de-ionized water.
Installing drag-in drag-out tanks	Install a drag-in drag-out rinse before and after the plating tank to ensure that drag-out is returned to the process at the same rate at which it is removed.

500 LEGAL REQUIREMENTS

Air Quality Legal Requirements for Printed Circuit Board Manufacturing

In this chapter we address air quality legal requirements for printed circuit board manufacturing, **beginning with district requirements and ending with pertinent verbatim sections of the California Health and Safety Code (HSC)**. Other environmental regulations also apply to noise, water, and hazardous materials, but they are not the *main* focus of this manual.

The California Legislature passes laws, called statutes, that authorize Executive Branch agencies such as the Air Resources Board (ARB) to implement these statutes by adopting and enforcing regulations. The ARB directly regulates air pollutant emissions from motor vehicles and some other sources. However, most industrial emission sources are regulated principally by the **Air Pollution Control Districts and Air Quality Management Districts.** Printed circuit boards are also regulated by other agencies, including the Department of Toxic Substances Control (DTSC) and the Office of Environmental Health Hazard Assessment (OEHHA).

501 DISTRICT REQUIREMENTS

Each local air district within the state, usually called an Air Pollution Control District, (**APCD**) or an Air Quality Management District (**AQMD**) has its own legal requirements based on its own special needs. These requirements vary from one district to another due to the nature of the particular air quality problems and the source types within the districts. A check list of the applicable rules for most districts are shown in Tables 501.1 - 501.4. A summary of the rules and permit requirements are shown in Section 600.

To assure compliance, the inspector is to collect and apply the rules for his or her local district. All districts have requirements in the following areas, each of which is discussed here, some in detail:

- Authority to Construct (including modifications)
- Permit to Operate
- Visible Emissions
- Particulate Matter Emissions
- Fugitive Dust Emissions
- Nuisances
- Breakdowns and Variances

500 LEGAL REQUIREMENTS

501.1 AUTHORITY TO CONSTRUCT AND PERMIT TO OPERATE

Conditions for the Construction and Operation

The districts use these two documents to permit the construction and operation of facilities and equipment which could cause air pollutant emissions. These documents also specify conditions for the construction and operation.

501.2 SPECIFIED CONDITIONS FOR PERMITS TO OPERATE

Permit to Operate

Under the authority of the California Health and Safety Code (HSC), and in order to comply with the California State Implementation Plan where applicable, the districts may issue conditions, other than the applicable general emissions limitations, for the operation of equipment and components of facilities. These conditions are stated in the Permit to Operate (PO), and often include such items as: operating hours, throughput, materials type and quantity, and emissions limits.

501.3 MAINTENANCE PROGRAM

Equipment Must be Properly Maintained and Kept in Good Operating Condition

The Permit to Operate stipulates that the equipment must be properly maintained and kept in good operating condition. The facility manager may also be directed to develop a maintenance program for the equipment listed in the Permit in order to preclude a violation of the California Health and Safety Code and applicable district rules and regulations.

501.4 MONITORING AND RECORDKEEPING

Documentation of Key Operating Parameters

Documentation of key operating parameters may be required in some Permits to Operate. The records may take the form of handwritten logbooks, completed preprinted forms, strip or circular recording charts from continuous recording readouts, or a computerized database. Computer records may do more than merely archive monitored operating parameters; they may also help the operator to analyze problems.

501.5 RULE VIOLATION

In the event that any equipment violates district rules and regulations, many districts require the facility manager to stop operating the pertinent equipment and proceed as necessary to end the violation. The facility manager must notify the district of any upset conditions, breakdown or scheduled maintenance which

causes emissions in excess of limits established by the district. A variance allowing a facility to temporarily pollute while it works towards compliance may be allowed by the local district hearing board if legal requirements are met.

501.6 FACILITY INSPECTION

The facility owner may be required to submit a periodic inspection report. The report may include the amount of emissions produced, operating conditions, calibration of monitoring instruments, and whether or not the operating conditions complied with the Permit to Operate or were within the manufacturer's specifications. Data from the report can be used for the emissions inventory and to validate the accuracy of monitoring records.

How to Perform an Inspection

How to perform an Inspection. This chapter, written primarily for the regulatory inspector, can be a source of information for conducting facility self-inspections. It can guide you through a complete compliance inspection of a PCB facility. It discusses procedures for pre-inspection, post inspection, sampling, and inspector safety. Guidelines and materials are provided to create a checklist.

Checklists

When you use your checklists, you may find rewards: Your inspections will be more effective, and **you will save time** as you are more aware of these aspects of your inspection:

- What to look for,
- What questions to ask,
- How to locate unpermitted PCB equipment, and
- How to conduct, complete, and document your inspection.

The standards and policies you need to determine compliance with each requirement will depend on *your* specific *district* rule and implementation strategy. You may place a copy of your district rule and your inspection aids in the appendix provided for it. The index can help you find the section and page number for additional information on specific issues.

First, follow the pre-inspection procedures. Review the source files and applicable rules, learn what equipment you may need, what information to exchange with the facility manager, and what to check for on the Permit to Operate.

Then, proceed with a complete compliance inspection, including PCB manufacturing equipment, operations, and administrative requirements.

Finally, the post-inspection procedures provide guidance on how to determine compliance rates, calculate excess emissions, and assure follow-up.

Be Prepared

501.6.1 Pre-Inspection Procedures

The objective of an inspection is to determine a facility's compliance with district regulations and Permits to Operate. It is essential to prepare for the inspection prior to visiting the site. Here are some guidelines, listing steps to follow prior to the inspection.

Review Your Files

501.6.2 File Review

Before the site inspection, review all information available in the district source files including:

1. Processes involved at the facility,
2. Source tests and emissions inventory,
3. Alternative emissions control plans,
4. Equipment lists,
5. Permit applications,
6. Permits approved,
7. Conditions for each permitted unit,
8. Previous inspection reports,
9. Reports of violations (note rule sections and equipment),
10. Enforcement action taken,
11. Complaints,
12. Variance history,
13. Abatement orders, and
14. Breakdown reports.

Review any References to Specific Rules

501.6.3 Regulation Review

Review any references to specific rules which are noted in the source files. Study and understand each standard and exemption in pertinent rules, bearing in mind that you may be asked to explain them. To clear up any confusion, discuss the requirements with experienced personnel to assure that there is a consistent interpretation of these requirements and how they are to be applied.

501.6.4 Inspection Forms

Since most district rules specify their own requirements for operations, equipment, and administration, you will want to use *your district's* inspection form. In designing an inspection form, it is helpful to solicit a response for each requirement and exemption, and you may wish to limit the length of the form to one page, using both sides.

To save time during the pre-inspection meeting, you may wish to complete some portions of the inspection document before the inspection.

501.6.5 Equipment Check

Assemble all the appropriate equipment to conduct your inspection. Consider the items you *may* need in order to protect yourself, to determine compliance, to calculate excess emissions, and to complete the inspection efficiently. The Compliance Assistance Program offers a technical manual on field safety programs for air quality personnel. Here are some of the items you may need:

Inspection and Safety Equipment

1. Vision and hearing protection, safety shoes, hard hat, and gloves,
2. Identification cards and business cards,
3. Forms for inspection and chain of custody,
4. Sampling supplies, if samples may be required: cans, labels, pens, seals, wipes, and container to carry cans,
5. Specialized equipment such as a visible emissions evaluation kit, with provisions for determining temperature, dewpoint, and wind, and
6. Tape measure, camera and film.

501.6.6 Pre-Entry and Entry

1. Upon arrival at the facility, smell the air and take an overall view:

   - Do you smell any odors outside or inside?
   - Do you see any emissions?
   - Note the size and layout of the facility.
   - Identify and prioritize potential problem areas to inspect first,
   - in case your time runs short.

2. Enter the facility through the normal public access.

3. Present your business credentials.

4. Request to see the contact person mentioned in the files, such as the ` president or a supervisor of environment, production, or maintenance.

Be prepared to cite and provide copies of these sections of the California Health & Safety Code (HSC) in case the source representative may not be familiar with your district's authority:

41510: Right of Entry
42303: Information Required

Refused Entry

Know your district's policy for **refused entry**.

501.6.7 Pre-Inspection Meeting

Before you begin your inspection, meet with the source operator, manager, or their representative to discuss the details which *either* of you may need to know before you conduct your inspection.

Talk With Your Host

Introduce yourself to the manager. This would be a good time to exchange business cards.

- Tell the manager that you intend to conduct a compliance inspection of the solvent cleaning equipment at the facility.

- Discuss any unfinished district business, such as variances, Authority to Construct, and any prior compliance problems.

- Tell the manager that you will need some assistance from him or her concerning the inspection and that you will brief him / her on your findings when the inspection is complete.

- Obtain facility information, including:

  - Name and ownership of the facility
  - Address of the facility
  - Name and title of the contact person
  - Phone number with area code

- Record the date and time of the inspection.
- Discuss sample collection if appropriate, and request copies you need, such as inventory reports or material safety data sheets (MSDS).
- Discuss safety procedures.

Pre-inspection Procedures

Review your district records with the facility manager to reconcile the number, type, and location of solvent equipment at the facility. Obtain current operating information about each one, and if any equipment is reported to be in storage, then make a note to assure, during the inspection, that it is in fact inoperative.

501.6.8 Facility Inspection Procedures

Begin the facility inspection, observing these **six points of inspection:**

- Capture / Point of Contaminant Generation
- Transport
- Air Mover
- Instrumentation
- Subsystem
- Control Device

Ask yourself questions about each aspect of the facility which will help you to determine compliance with your district's regulations and permit conditions. Most districts have developed inspection forms tailored for their own regulations and permit conditions. Write the answers on the form.

Begin the inspection by checking the Permits to Operate for each permitted item. Verify that the equipment operates in accordance with the permit conditions and district regulations. Most district regulations also include emission reduction requirements, solvent storage and disposal requirements, facility exemptions, and recordkeeping; consider all of these aspects.

A current Permit to Operate must be posted on or near the equipment. Determine whether the equipment has been altered since the Permit was last issued. If the equipment has been modified, check to see that an Authority to Construct was granted. A Notice of Violation is appropriate if the permit procedures were not followed or if the source is not in compliance with district permit

conditions. **Many districts also require operating practices to be posted.**

Compliance with Regulations. Check compliance with the regulations associated with PCB facilities, including the requirements for **toxics.** Tables 501.1 through 501.4 identify possible district rules that may apply to certain manufacturing processes. The rules identified in these tables are current as of March 1998. It is your responsibility to check with your local air pollution control district as to the current rules and regulations regarding the PCB industry. You should update the table as the rules and regulations change and enter the date in the space provided at the bottom of each table.

Table 501.1
Printed Circuit Board Manufacturing District Rule Inspection Check List (Reg.-Rule-Section)

Manufacturing Process	Bay Area AQMD	South Coast AQMD	San Diego County APCD	San Joaquin Valley APCD	Ventura County APCD
Shearing	exempt, 2-1-125.1.2	exempt, 219-g-1	usually exempt	maybe subject to permit	exempt, II-23.B.4
Core Preparation	exempt, 2-1-118.4, 2-1-118.5	exempt, 219-g-1, 219-1-4	maybe exempt II-11-d-16, IV-67.6	2020, 2010, 4001, 4002, 4661.	II-23.F.1.0.a, II-23.I.9, IV-74.6
Dry Film Photo Resist Application	2-1-119.2.2, 8-4	219-h-1	maybe exempt II-11	2010, 4001, 4002, 4607, 4661.	II-23.F.11.b
Negative Image Exposure	exempt, 2-1-127.2	exempt, 219-h-1, 219-h-2	maybe exempt II-11	maybe subject to permit	exempt
Developer	2-1-118.5, 2-1-103, 8-4	exempt, 219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661.	II-23.F.15, IV-74.6
Etcher	2-1-127.4, 2-1-103, 8-4, 7	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661.	II-23.F.15, II-23.I.9, IV-51
Photo Resist Stripper	2-1-118.5, 2-1-103, 8-4,	219, 201, 203	maybe exempt II-11, IV-67.6	2020, 2010, 4001, 4002, 4661.	II-23.F.15, II-23.I.9
Oxide Line	2-1-118.4, 2-1-118.5	exempt, 219-1-4	maybe exempt II-11	2010, 4001, 4002, 4661.	II-23.I.9
Lay Up Area	exempt	exempt, 219-1-4	exempt	2020	exempt
Inner Layers Assembly	exempt	exempt, 219-1-4	exempt	2020	exempt
Multilayer Lamination Press	2-1-103	exempt, 219	exempt	2020	II-23.F.12, IV-74.20
Circuit Board Drilling	2-1-125.1.2, 6-301	exempt, 219-g-1	permit required part of drilling	2020, 2010, 4001, 4101, 4002, 4201	II-23.B.4
Baghouse	2-1-113.2.4, 2-1-316	exempt, 219-g-1	IV-50	permit required	II-23.B.4, IV-50
Electroless Copper Plating Line and Metalization	8-4	1401, 219	maybe exempt II-11	2020, 2010, 4001, 4002, 4661.	II-23.I.9, IV-74.12
De-Smear Conditioner	2-1-118.4, 2-1-118.5, 2-1-103, 8-4	usually exempt 219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661.	II-23.F.15, II-23.I.9, IV-74.6

Table 501.2
Printed Circuit Board Manufacturing District Rule Inspection Check List (Reg.-Rule-Section)

Manufacturing Process	Bay Area AQMD	South Coast AQMD	San Diego County APCD	San Joaquin Valley APCD	Ventura County APCD
De-Smear Permanganate Tank	2-1-103, 2-1-118.5	usually exempt 219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.I.9, 23.F.10.d, IV-74.6
De-Smear Plasma Etching	2-1-124.1.4, 2-1-128.19, 2-1-316	usually exempt 219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.I.9, 23.F.10.d, IV-74.6
Catalyst Application	2-1-125.1.1	1401, 219, 201, 203	maybe exempt II-11	2020	II-23.I.9
Electroless Copper Bath	2-1-125.1.1, 2-1-316, 8-4	1401, 219	maybe exempt II-11	2020	II-23.I.9, IV-51
Anti Tarnish	2-1-119.2, 2-1-103, 8-4	exempt, 219-g-1, 219-1-4	maybe exempt II-11	2020	II-23.I.9, IV-51
Dry Film Photo Resist Application (Outer Layer)	2-1-119.2, 8-4	219-h-1	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.11.b, IV-74.20
Negative Image Exposure	2-1-127.2	219-h-1, 219-h-2	maybe exempt II-11	2020	exempt
Developer	2-1-118.5, 2-1-103, 8-4	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.F.10
Electroplating	2-1-125.1.1, 2-1-127.3, 8-4	219-1-5	maybe exempt II-11	2020	II-23.I.9
Tin and Tin Lead Plating	2-1-125.1.1	219-1-5	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.I.9
Photo Resist Stripper	2-1-118.5, 2-1-103, 8-4	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.F.10.d, IV-74.6, IV-74.C.1.e
Etcher	2-1-127.4, 2-1-103, 8-4, 7,	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.I.9, IV-51
Tin and Tin Lead Stripping	2-1-118.4, 2-1-118.5, 2-1-127.3, 2-1-1-103,	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.I.9
Liquid Photo Imageable (LPI) Solder Mask	2-1-119.2, 2-1-103, 8	219-h-1	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.I.7, , IV-74.19, IV-74.19.1

Table 501.3
Printed Circuit Board Manufacturing District Rule Inspection Check List (Reg.-Rule-Section)

Manufacturing Process	Bay Area AQMD	South Coast AQMD	San Diego County APCD	San Joaquin Valley APCD	Ventura County APCD
Tack Dry Oven	2-1-119.4, 2-1-103	219-h-1	maybe exempt II-11	2020, 2010, 4001, 4002, 4101, 4201	II-23.C.1, IV-50, IV-51
Image Exposure	2-1-127.2	219-h-1, 219-h-2	maybe exempt II-11	2020	exempt
Solder Mask Developer	2-1-118.4, 2-1-118.5, 2-1-103	219-1-4	maybe exempt II-11	2020, 2010, 4001, 4002, 4661	II-23.F.15, IV-74.6
Solder Mask and Final Cure Oven	2-1-119.4, 2-1-103, 2-1-116.10	219-h-1	maybe exempt II-11	2020, 2010, 4001, 4002, 4101, 4661	II-23.C.1, IV-50, IV-51
Solder Mask Stripper	2-1-118.4, 2-1-118.5, 2-1-103, 8-4	219-1-10	67.6	2020, 2010, 4001, 4002, 4661	II-23.F.15, II-23.F.10, IV-74.6, IV-74.C.1.e
Stencil Cleaning	2-1-118.4, 2-1-118.7, 8-4	219-1-10	maybe exempt II-11	2020, 2010 4001, 4002, 4607	II-23.F.13, IV-74.6.C.1, IV-74.19.C.1.5, IV-74.19.1.C.4
Silk-Screening Cleaning Booth	2-118.4, 2-1-118.9, 8-4	exempt	IV-67.6	2020, 2010, 4001, 4002, 4607	II-23.F.15, II-23.F.10, IV-74.6, IV-74.19, IV-74.19.1
Preclean and Flux Application	2-1-118.4, 2-1-118.5, 2-1-103, 8-4	permit required	IV-67.3	2020	II-23.I.7, IV-74.6
Hot Air Leveling	2-1-125.1.3, 2-1-316	permit required	IV-66	2020, 2010, 4001, 4002, 4661	II-23.I.7
Alternate Organic Coating	2-1-103, 2-1-119.2, 8-4	219-1-10, 219-1-16	IV-67.9	2020, 2010, 4001, 4002, 4661	exempt
Flux Immersion Tray	2-1-103, 8-4	Part of Solder Flow	IV-67.6	2020	II-23.F.11.b, IV-26
Solder Reflow	2-1-103, 8-4, 6-301	201, 203	IV-66	2020, 2010, 4002, 4607	II-23.I.7

Table 501.4
Printed Circuit Board Manufacturing District Rule Inspection Check List (Reg.-Rule-Section)

Manufacturing Process	Bay Area AQMD	South Coast AQMD	San Diego County APCD	San Joaquin Valley APCD	Ventura County APCD
Legend Application	2-1-119.2, 2-1-103, 8-4, 8-16	219-h-1	IV-66	2020, 2010, 4001, 4002, 4607	II-23.F.13, IV-74.19.1
Legend Ink Cure Oven	2-1-119.4, 2-1-103	219-h-1	permit maybe required	2020, 2010, 4001, 4002, 4607	IV-23.F.13, IV-50, IV-51
Circuit Board Panel Routing	2-1-125.1.2, 6-301	219-g-1	IV-50	2020, 2010, 4001, 4002, 4101, 4201	II-23.B.4, IV-50, IV-51
Hand Assembly	2-1-118.4, 2-1-118.6, 2-118.9, 2-125.1.3, 2-103, 8-1, 8-4, 8-16	219-e-6	II-11	2020, 2010, 4001, 4002, 4101, 4201, 4661	II-23.F.10, IV-74.6
Solder Paste Application	2-1-119.2, 2-1-103, 8-1, 8-4, 8-16	exempt	II-11	2020	II-23.F.I.7, IV-74.19, IV-74.19.1
Surface Mount	exempt	exempt	exempt	exempt	exempt
Inspection	exempt	exempt	exempt	exempt	exempt
Solder Paste Reflow	2-1-119.4	219-e-6	II-11	2020	II-23.I.7
Wave Solder	2-1-118.4, 2-118.5, 2-1-125.1.3, 2-1-103, 8-4	219-e-6	IV-50, IV-66	2020	II-23.I.7, II-23.F.10
Cleaning	2-1-118.4 through 2-1-118.7, 2-1-316, 8-16	219-1-10	II-11	2020, 2010, 4001, 4002,4661	IV-74.6, IV-74.6.1, IV-74.6.2, IV-74.6.3

501.7 MAINTENANCE LOGS

Permit conditions may require records of maintenance performed. These records must be retained for specified periods of time, typically three years, and they must be made available to the air pollution control district upon request.

501.8 MANUALS FOR OPERATION AND MAINTENANCE

Some Permits require operators to obtain and be familiar with an Operations and Maintenance Manual (O&M) prepared specifically for their facility. The manufacturer may have prepared most of this information. These manuals typically include:

- General information about the facility design and equipment.
- Plans describing procedures and operating parameters.
- Plans describing preventive maintenance schedules, inspection and repair programs, and the recommended spare parts inventory.
- Emergency procedures for fires, gas leaks, power losses, waste spills, etc.
- MSDS information

Many permits require that the equipment be operated in accordance with the manufacturer's instructions, unless the instructions conflict with district rules or permit conditions. The manufacturer instructions and procedures, along with the Operating Permit, typically must be posted on the control panel or other equipment, and be readily visible or available to the operator.

502 NEW SOURCE REVIEW

NSR

In both attainment and nonattainment areas, whenever new plants are built or emissions from existing sources increase as a result of expansion, a New Source Review (NSR) is triggered. Each air pollution control district has it own NSR rule which is based on the attainment and nonattainment area criteria listed below. It is suggested that the reader refer to his/hers district rule to determine all requirements that may apply to a given area.

PSD

Special rules apply in attainment areas. These are called Prevention of Significant Deterioration (PSD) requirements and include the following:

- Installation of Best Available Control Technology (BACT). EPA determines BACT requirements by: (1) identifying all control technologies; (2) eliminating technically infeasible options; (3) ranking remaining control effectiveness; (4) evaluating the most effective controls and documenting results; and (5) selecting BACT;

- A detailed air quality analysis showing that there will be no violation of PSD "increments";

- Prediction of future air quality standards; and

- Possible monitoring of air quality for one year prior to the issuance of the permit.

Restrictions in nonattainment areas are more severe. The principal requirements of NSR in nonattainment areas are:

- Installation of Lowest Achievable Emission Rate (LAER) technology. LAER is the most stringent emission limitation derived from either of the following: (1) the most stringent emission limitation contained in the State Implementation Plan (SIP) for such class or category of source; or (2) the most stringent emission limitation achieved in practice by such class or category of source.

- Provision for "offsets" representing emission reductions that must be made by other sources; and

- Demonstration of standard attainment through the undertaking of an air quality analysis.

Requirements Pollutant Specific

The PSD and NAA (nonattainment area) requirements are pollutant-specific. For example, although a facility may emit many air pollutants, only one or a few may be subject to the PSD or NAA permit requirements, depending on the magnitude of the emissions of each pollutant. Also, a source may have to obtain both PSD and NAA permits if the source is in an area which is designated nonattainment for one or more of the pollutants.

503 VISIBLE EMISSIONS (VE)

VE

USEPA Method 9 (Visual Determination of the Opacity of Emissions from Stationary Sources) is found in Appendix B. The method requires the recording of certain specific information in the field documentation of a visible emission observation. The required information includes the name of the facility, the emission location, the type of facility, the observer's name and affiliation, the date, the time, the estimated distance to the emission location, the approximate wind speed and direction, a description of the sky, and the plume background, in addition to a minimum of 24 consecutive opacity observations taken once every 15 seconds.

Smoke Reading

In California, the visible emission regulation is in Section 41701 of the California Health and Safety Code. The limit in the Health and Safety Code is a Ringelmann No. 2 for dark colored emissions and is 40% opacity for light colored emissions. The Ringelmann chart is a gray to black smoke scale published by the United States Bureau of Mines with a range from 0 to 5. "0" represents no visible smoke and "5" is 100% opaque or totally black smoke. In most local air quality districts, the acceptable limit is Ringelmann No. 1 or 20% opacity. California provides that an aggregate of any 13 or more readings above the limit (totalling more than 3 minutes) taken in a 1-hour period is a violation.

The Compliance Division of the ARB conducts a "Fundamentals of Enforcement" class four times a year to train and certify government and industry personnel to perform these evaluations. The certification is valid for a period of six months, after which recertification is required.

Observe all stacks for emissions which would violate the opacity or Ringelmann limitations in your district regulations. Remember, you must be certified to do a visible emissions evaluation. A visible emissions evaluation (VEE) kit should be available to the inspector. The kit should include:

VEE Forms	Range finder - to measure distance to the stack
Binoculars	Psychrometer - to calculate relative humidity
Wind gauge	Inclinometer - to measure angle of view to stack
Stop Watch	Compass
Camera and film	Water bottle
Pens	Ringelmann chart
Flashlight	

503.1 PARTICULATE MATTER EMISSION LIMITS

Air pollution control districts have general rules which apply to any source operation which emits or may emit dust, fumes, or suspended particulate matter. Some rules specify limits by concentration, in grains per cubic foot, for example; other rules specify weight of emissions per unit of production. Most districts have both limits. To determine the concentrations of particulate emissions at facilities, most districts use ARB Method 5. EPA Method 9 is very similar and can also be used, a copy is in Appendix B.

503.2 NUISANCE

District rules based on Section 41700, HSC, protect the public's health and welfare from the discharge of air contaminants which constitute a public nuisance. This concept includes protection from injury, detriment, and annoyances such as odors from emissions.

504 EQUIPMENT BREAKDOWN PROVISIONS

Each district has an equipment breakdown (or excusable equipment malfunction) rule. The rule enables a source qualifying under stated conditions to avoid enforcement action otherwise precipitated by failure of that source to comply with air pollution regulations as a result of a malfunction of any air pollution control equipment or related operating equipment. Malfunctions of in-stack monitoring equipment are also addressed in the rule.

Sources should keep a copy of the breakdown rule on location. They should also be familiar with their responsibilities in the event of an equipment malfunction.

The conditions that a malfunction must meet in order to qualify for district breakdown provisions vary from district to district. Typically, the following are conditions for an acceptable breakdown:

Breakdown Conditions

1. The breakdown must result from a failure that was unforeseeable;
2. It must not be the result of neglect or disregard of any air pollution control l law or rule or regulation;
3. It must not be intentional, or the result of negligence;
4. It must not be the result of improper maintenance;
5. It must not constitute a nuisance; and

6. It must not be an abnormally recurrent breakdown of the same equipment.

District rules also list a number of procedures which must be followed in reporting the breakdown in a timely manner to the district. If the breakdown is not reported to the district within the allowed time period, as stated in the rule, a separate violation occurs, for which enforcement action is appropriate.

When a breakdown is reported to the district it is recorded in the district's breakdown log. Sources must provide the district with the following information:

Breakdown Procedures

1. The source's name and location, and the source contact's name and telephone number;
2. The specific equipment affected by the breakdown;
3. The specific equipment that failed;
4. The date and time that the breakdown occurred;
5. The date and time that the breakdown is being reported to the district
6. The source's proposed action; and
7. The estimated emissions resulting from breakdown.

Breakdown Reports

Upon receipt of a breakdown report, the district performs an investigation to determine whether the malfunction meets the prescribed breakdown conditions. This investigation includes an onsite inspection of the malfunctioning equipment. If the inspector does not find a breakdown condition at the source, he may take appropriate enforcement action including, but not limited to, seeking fines, an abatement order, or an injunction against further operation.

If a source files a breakdown report which falsely, or without probable cause, claims a malfunction to be a breakdown occurrence, this shall constitute a separate violation. The burden of proof shall be on the source to provide sufficient information that a breakdown did occur. If the source fails to do this, the district will undertake appropriate enforcement action.

A source with a breakdown must take immediate steps to correct the equipment malfunction as quickly as possible. If a source finds that a malfunction cannot be repaired within the district's allowable duration of a breakdown, the source may file for an emergency **variance** in order to avoid enforcement action.

District rules require sources to submit in writing the following details to the

Correction

district air pollution control officer within a stated time period of the correction of the breakdown occurrence:

1. The duration of excessive emissions;
2. An estimate of the quantity of excess emissions;
3. A statement of the cause of the occurrence;
4. Corrective measures to be taken to prevent recurrences; and
5. Proof of the source's return to compliance, including the date and time that the breakdown was corrected.

Besides the information mentioned above, the district log will also include the following items, some of which will be filled in as the case continues:

1. A confirmation that the breakdown is allowable under district rules;
2. The name of the district investigator;
3. The initial inspection file number;
4. The compliance confirmation inspection file number;
5. The date that the breakdown correction report was filed by the source; and
6. An indication if a variance was requested.

505 VARIANCES

Variance

A source may petition for a variance if either of the following is true:

1. Pollution control equipment has broken down and meets the criteria for breakdown condition under district rules; however, the source operator finds that it will take longer to repair the breakdown than provided for under the district breakdown rule. In such a case, a source operator may wish to apply for an emergency variance.

2. A source finds itself to be out of compliance, is found to be out of compliance, or expects to soon be out of compliance, with any air pollution control district rule or regulation, or with Section 41701 of the California Health and Safety Code (H&SC).

If a source falls into either of the above categories at any time, it should consider applying for a variance. A source's purpose in applying for a variance is to attempt to shield itself from state and local enforcement action while it is out of compliance. Federal regulations do not have a variance provision and a variance cannot protect against federal enforcement actions. Sources should be advised

that the initiative to file for a variance and to prove that they need a variance rests on them.

Interim Variance

A source can apply for a short variance (90 day maximum) or a regular variance (over 90 days and 1 year maximum unless a schedule of increments of progress is included). Interim variances are also available which gives the source protection from enforcement action until their original application for variance can be noticed and heard by the hearing board, or up to 90 days, whichever is shorter. Interim and emergency variance orders, if issued, are typically granted the same day they are requested. A written petition must be submitted before these (and all other) variances are granted.

It is the source's responsibility to estimate the amount of time it will need to be under variance, and to then apply for the appropriate type of variance.

A source should be aware that the decision on whether to grant any variance rests with the district variance hearing board and not with the air pollution control officer or that person's staff.

Rules for variance procedures vary from district to district. The district rules are based on H&SC statutes, however, in some districts the rules are stricter than H&SC requirements. Some of the applicable statutes are listed in Section 505 of this manual. District personnel as well as source operators should be familiar with these statutes and with the local district variance rules.

With regard to variances, State law (H&SC) requires that:

H&SC Requirements

1. The district should not allow sources to operate in violation of district rules without a variance, even if the source is working towards finding a solution to the problem. Source operators should be aware that under H&SC Section 42400.2, if they continue to operate in violation of district rules, they are subject to a $25,000 per day fine and up to 12 months in county jail.

2. All variance hearings should be noticed properly in accordance with H&SC Sections 40823 through 40827. Section 40826 requires a 30-day notice period for hearings for variances over a 90-day duration.

3. No variance shall be granted unless the hearing board makes all of the findings listed in H&SC, Section 42352.

CARB Recommendations

The Air Resources Board recommends that the following procedures be observed in the various stages involved from the time a source petitions for a variance through the end of the variance period. Some of these recommendations may not be a part of all districts' variance programs at this time; or, they may be written but not implemented procedures.

1. Parties petitioning for variances should be required to fill out a petition form in writing.

2. The district will require sources to provide excess emissions figures on the petitions they submit. This information will be evaluated by the district staff. The emission figures are presented to the hearing board, so that the board formally recognizes, and the public may be aware of, the emissions impact of the variance. If the variance is granted, these limits must be included in the final variance order.

3. An interim variance can be granted to cover the time period from filing the petition for a regular or short variance until a decision is rendered on whether the variance is granted. This interim variance can subject the source to operating conditions during that interim period.

4. Variances should not be granted retroactively. The date that variance coverage begins cannot predate the date on which the petition was filed.

5. Each variance order will specify the equipment under variance and the district rule or regulation violated.

6. The district should schedule increments of progress for sources under variance. Increments of progress are required for variances over one year. District staff should verify that the source is meeting these increments of progress.

7. The district should require the source to quantify excess emissions that will occur during the period of variance.

8. At the end of the variance period, the district shall inspect the source to ensure that it is in compliance with all district air pollution regulations.

506 HEALTH AND SAFETY CODE

The following California Health and Safety Code (H&SC) references are included to demonstrate the authority of district air pollution control districts to adopt regulations, issue permit conditions, perform inspections and pursue enforcement action. Please note that **these regulations are subject to change** and the reader is cautioned to **refer to the current version of the H&SC** when necessary. The relevant Health and Safety Code Sections are presented in numerical order:

HSC Sections in Numerical Order

39000 Legislative Findings - Environment
39001 Legislative Findings - Agency Coordination
39002 Local and State Agency Responsibilities
39003 ARB Responsibilities
40000 Local/State Responsibilities
40001 Adoption and Enforcement of Rules and Regulations
40702 Adoption of Rules and Regulations
40823 Hearing Board Shall Serve 10 Days Notice
40824 Reasonable Notice for Interim Variance
40825 10 Day Notice for Variances up to 90 Days
40826 30 Day Notice for Regular Variances
41509 No Limitation on Power to Abate Nuisance
41510 Right of Entry With Inspection Warrant
41700 No Person Shall Discharge Pollutants (Public Nuisance)
41701 No Emissions Shall Exceed Ringelmann 2 (Ringelmann/ Opacity Standards)
42300 District Permit System
42301 Requirements For Permit Issuance
42303 Air Contaminant Discharge: Information Disclosure
42303.5 False Statements in Permit Applications
42304 Permit Suspension (Failure to Supply Information)
42350 Applications for Variance
42351 Interim Variance Applications
42351.5 Interim Authorization of Schedule Modification
42352 Findings Required for Issuance of Variance
42353 Other Requirements for Specified Industry, Business, Activity or Individuals
42354 Wide Discretion in Prescribing Requirements
42355 Hearing Board Bond Requirements
42356 Hearing Board Variance Modification or Revocation

42357 Hearing Board Review of Schedule of Increments of Progress or Final Compliance Date
42358 Effective Period of Order, Final Compliance Date
42359 Public Hearing Requirements; Emergency Exceptions
42359.5 Emergency Variances
42360 Copy of Variance Orders to ARB
42361 Validity of Variance Time
42362 Variance Revocation or Modification
42363 ARB Hearing Prior to Action
42364 Schedule of Fees
42400 General Violations, Criminal
42400.1 Negligence, Criminal
42400.2 Document Falsification or Failure to Take Corrective Action, Criminal
42400.3 Willfully and Intentionally Emitting an Air Contaminant
42401 Violating Order of Abatement, Civil
42402 General Violations, Civil
42402.1 Negligence or Actual Injury, Civil
42402.2 Document Falsification or Failure to Take Corrective Action, Civil
42402.3 Civil Penalties
42402.5 Administrative Penalties
42403 Recovery of Civil Penalties
42404.5 Statute of Limitations for Civil Actions
42450 Orders of Abatement: District Board; Authority; Notice and Hearing
42700 Monitoring Devices: Legislative Findings & Declarations
42701 Determination of Availability, Technological Feasibility, and Economic Reasonableness
42702 Specification of Types of Stationary Sources, Processes and Contaminants
42703 Reimbursement for Actual Testing Expenses
42704 Determination of Availability; Revocation or Suspension
42705 Records
42706 Report of Violation of Emission Standard
42707 Inspection; Fees
42708 Powers of Local or Regional Authority

39000 LEGISLATIVE FINDINGS - ENVIRONMENT

The Legislature finds and declares that the people of the State of California have a primary interest in the quality of the physical environment in which they live, and that this physical environment is being degraded by the waste and refuse of civilization polluting the atmosphere, thereby creating a situation which is detrimental to the health, safety, welfare, and sense of well-being of the people of California.

39001 AGENCY COORDINATION

The Legislature, therefore, declares that this public interest shall be safeguarded by an intensive, coordinated state, regional, and local effort to protect and enhance the ambient air quality of the state. Since air pollution knows no political boundaries, the Legislature declares that a regional approach to the problem should be encouraged whenever possible and, to this end, the state is divided into air basins. The state should provide incentives for such regional strategies, respecting, when necessary, existing political boundaries.

39002 LOCAL AND STATE RESPONSIBILITIES

Local and regional authorities have the primary responsibility for control of air pollution from all sources other than vehicular sources. The control of vehicular sources, except as otherwise provided in this division, shall be the responsibility of the State Air Resources Board. Except as otherwise provided in this division, including, but not limited to, Sections 41809, 41810, and 41904, local and regional authorities may establish stricter standards than those set by law or by the state board for nonvehicular sources. However, the state board shall, after holding public hearings as required in this division, undertake control activities in any area wherein it determines that the local or regional authority has failed to meet the responsibilities given to it by this division or by any other provision of law.

39003 ARB RESPONSIBILITIES

The State Air Resources Board is the state agency charged with coordinating efforts to attain and maintain ambient air quality standards, to conduct research into the causes of and solution to air pollution, and to systematically attack the

serious problem caused by motor vehicles, which is the major source of air pollution in many areas of the state.

40000 LOCAL/STATE RESPONSIBILITIES

The Legislature finds and declares that local and regional authorities have the primary responsibility for control of air pollution from all sources, other than emissions from motor vehicles. The control of emissions from motor vehicles, except as otherwise provided in this division, shall be the responsibility of the state board.

40001 ADOPTION OF REGULATIONS

(a) Subject to the powers and duties of the state board, the districts shall adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by emission sources under their jurisdiction, and shall enforce all applicable provisions of state and federal law.

(b) The district rules and regulations may, and at the request of the state board shall, provide for the prevention and abatement of air pollution episodes which, at intervals, cause discomfort or health risks to, or damage to the property of, a significant number of persons or class of persons.

(c) Prior to adopting any rule or regulation to reduce criteria pollutants, a district shall determine that there is a problem that the proposed rule or regulation will alleviate and that the rule or regulation will promote the attainment or maintenance of state or federal ambient air quality standards.

(d) (1) The district rules and regulations shall include a process to approve alternative methods of complying with emission control requirements that provide equivalent emission reductions, emissions monitoring, or recordkeeping.

(2) A district shall allow the implementation of alternative methods of emission reduction, emissions monitoring, or recordkeeping if a facility demonstrates to the satisfaction of the district that those alternative methods will provide equivalent performance. Any alternative method of emission reduction, emissions monitoring, or recordkeeping proposed by the facility shall not violate other provisions of law.

(3) If a district rule specifies an emission limit for a facility or system, the district shall not set operational or effectiveness requirements for any specific emission control equipment operating on a facility or system under that limit. Any alternative method of emission reduction, emissions monitoring, or recordkeeping proposed by the facility shall include the necessary operational and effectiveness measurement elements that can be included as permit conditions by the district to ensure compliance with, and enforcement of, the equivalent performance requirements of paragraphs (1) and (2). Nothing in this subdivision limits the district's authority to inspect a facility's equipment or records to ensure operational compliance. This paragraph shall apply to existing rules and facilities operating under those rules.

40702 ADOPTION OF RULES AND REGULATIONS

A district shall adopt rules and regulations and do such acts as may be necessary or proper to execute the powers and duties granted to, and imposed upon, the district by this division and other statutory provisions. No order, rule, or regulation of any district shall, however, specify the design of equipment, type of construction, or particular method to be used in reducing the release of air contaminants from railroad locomotives.

40823 HEARINGS - 10 DAYS NOTICE

(a) Except as otherwise provided in Sections 40824, 40825, and 40826, a hearing board shall serve a notice of the time and place of a hearing upon the district air pollution control officer, and upon the applicant or permittee affected, not less than 10 days prior to such hearing.

(b) Except as otherwise provided in Sections 40824, 40825, and 40826, the hearing board shall also send notice of the hearing to every person who requests such notice and obtain publication of such notice in at least one daily newspaper of general circulation within the district. The notice shall state the time and place of the hearing and such other information as may be necessary to reasonably apprise the people within the district of the nature and purpose of the meeting.

40824 REASONABLE NOTICE - INTERIM VARIANCE

In case of a hearing to consider an application for an interim variance, as authorized under Section 42351:

(a) The hearing board shall serve reasonable notice of the time and place of the hearing upon the district air pollution control officer and upon the applicant.

(b) Subdivision (b) of Section 40823 shall not apply.

(c) In districts with a population of less than 750,000, the chairperson of the hearing board, or any other member of the hearing board designated by the board, may hear an application for an interim variance. If any member of the public contests a decision made by a single member of the hearing board, the application shall be reheard by the full hearing board within 10 days of the decision.

40825 10 DAY NOTICE - 90 DAY VARIANCES

In case of a hearing to consider an application for a variance, or a series of variances, to be in effect for a period of not more than 90 days, or an application for modification of a schedule of increments of progress:

(a) The hearing board shall serve a notice of the time and place of a hearing to grant such a variance or modification upon the air pollution control officer, all other districts within the air basin, the state board, the Environmental Protection Agency, and upon the applicant or permittee, not less than 10 days prior to such hearing.

(b) Subdivision (b) of Section 40823 shall not apply.

(c) In districts with a population of less than 750,000, the chairman of the hearing board, or any other member of the hearing board designated by the board, may hear such an application. If any member of the public contests a decision made by a single member of the hearing board, the application shall be reheard by the full hearing board within 10 days of the decision.

40826 30 DAY NOTICE - REGULAR VARIANCES

In case of a hearing to consider an application for a variance, other than an interim variance or a 90-day variance, or an application for a modification of a final compliance date in a variance previously granted, the notice requirements for the hearing shall be as follows:

(a) The hearing board shall serve a notice of the time and place of a hearing to grant a variance upon the air pollution control officer, all other districts within the air basin, the state board, the Environmental Protection Agency, and upon the applicant or permittee, not less than 30 days prior to the hearing, except as provided in subdivision (d).

(b) The hearing board shall also publish a notice of the hearing in at least one daily newspaper of general circulation in the district, and shall send the notice to every person who requests the notice, not less than 30 days prior to the hearing, except as provided in subdivision (d).

(c) The notice shall state the time and place of the hearing; the time when, commencing not less than 30 days, or, under subdivision (d), not less than 15 days, prior to the hearing, and place where the application, including any proposed conditions or schedule of increments of progress, is available for public inspection; and any other information that may be necessary to reasonably apprise the people within the district of the nature and purpose of the meeting.

(d) In districts with a population of 750,000 or less, the hearing board shall serve, publish, and send the notice pursuant to subdivisions (a) and (b) not less than 15 days prior to the hearing.

41509 POWER TO ABATE NUISANCE

No provision of this division, or of any order, rule, or regulation of the state board or of any district, is a limitation on:

(a) The power of any local or regional authority to declare, prohibit, or abate nuisances.

(b) The power of the Attorney General, at the request of a local or regional authority, the state board, or upon his own motion, to bring an action in the name of the people of the State of California to enjoin any pollution or nuisance.

(c) The power of a state agency in the enforcement or administration of any provision of law which it is specifically permitted or required to enforce or administer.

(d) The right of any person to maintain at any time any appropriate action for relief against any private nuisance.

41510 RIGHT OF ENTRY

For the purpose of enforcing or administering any state or local law, order, regulation, or rule relating to air pollution, the executive officer of the state board or any air pollution control officer having jurisdiction, or an authorized representative of such officer, upon presentation of his credentials or, if necessary under the circumstances, after obtaining an inspection warrant pursuant to Title 13 (commencing with Section 1822.50), Part 3 of the Code of Civil Procedure, shall have the right of entry to any premises on which an air pollution emission source is located for the purpose of inspecting such source, including securing samples of emissions therefrom, or any records required to be maintained in connection therewith by the state board or any district.

41700 PUBLIC NUISANCE

Except as otherwise provided in Section 41705, no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

41701 RINGELMANN / OPACITY STANDARDS

Except as otherwise provided in Section 41704, or Article 2 (commencing with Section 41800) of this chapter other than Section 41812, or Article 2 (commencing with Section 42350) of Chapter 4, no person shall discharge into the atmosphere from any source whatsoever any air contaminant, other than uncombined water vapor, for a period or periods aggregating more than three minutes in any one hour which is:

(a) As dark or darker in shade as that designated as No. 2 on the Ringelmann Chart, as published by the United States Bureau of Mines, or

(b) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subdivision (a).

42300 DISTRICT PERMIT SYSTEM

(a) Every district board may establish, by regulation, a permit system that requires, except as otherwise provided in Section 42310, that before any person builds, erects, alters, replaces, operates, or uses any article, machine, equipment, or other contrivance which may cause the issuance of air contaminants, the person obtain a permit to do so from the air pollution control officer of the district.
(b) The regulations may provide that a permit shall be valid only for a specified period. However, the expiration date of any permit shall be eligible for extension upon completion of the annual review required pursuant to subdivision (e) of Section 42301 and payment of the fees required pursuant to Section 42311, unless the air pollution control officer or the hearing board has initiated action to suspend or revoke the permit pursuant to Section 42304, 42307, or 42309, that action has resulted in a final determination by the officer or the board to suspend or revoke the permit, and all appeals have been exhausted or the time for appeals from that final determination has been exhausted.
(c) The annual extension of a permit's expiration date pursuant to subdivision (b) does not constitute permit issuance, renewal, reopening, amendment, or any other action subject to the requirements specified in Title V.

42301 REQUIREMENTS FOR PERMIT ISSUANCE

A permit system established pursuant to Section 42300 shall do all of the following:

(a) Ensure that the article, machine, equipment, or contrivance for which the permit was issued does not prevent or interfere with the attainment or maintenance of any applicable air quality standard.

(b) Prohibit the issuance of a permit unless the air pollution control officer is satisfied, on the basis of criteria adopted by the district board, that the article, machine, equipment, or contrivance will comply with all of the following:

(1) All applicable orders, rules, and regulations of the district and of the state board.

(2) All applicable provisions of this division.

(c) Prohibit the issuance of a permit to a Title V source if the Administrator of the Environmental Protection Agency objects to its issuance in a timely manner as provided in Title V. This subdivision is not intended to provide any authority to the Environmental Protection Agency to object to the issuance of a permit other than that authority expressly granted by Title V.

(d) Provide that the air pollution control officer may issue to a Title V source a permit to operate or use if the owner or operator of the Title V source presents a variance exempting the owner or operator from Section 41701, any rule or regulation of the district, or any permit condition imposed pursuant to this section, or presents an abatement order that has the effect of a variance and that meets all of the requirements of this part pertaining to variances, and the requirements for the issuance of permits to operate are otherwise satisfied. The issuance of any variance or abatement order is a matter of state law and procedure only and does not amend a Title V permit in any way. Those terms and conditions of any variance or abatement order that prescribe a compliance schedule may be incorporated into the permit consistent with Title V and this division.

(e) Require, upon annual renewal, that each permit be reviewed to determine that the permit conditions are adequate to ensure compliance with, and the enforceability of, district rules and regulations applicable to the article, machine, equipment, or contrivance for which the permit was issued which were in effect at the time the permit was issued or modified, or which have subsequently been

adopted and made retroactively applicable to an existing article, machine, equipment, or contrivance, by the district board and, if the permit conditions are not consistent, require that the permit be revised to specify the permit conditions in accordance with all applicable rules and regulations.

(f) Provide for the reissuance or transfer of a permit to a new owner or operator of an article, machine, equipment, or contrivance. An application for transfer of ownership only, or change in operator only, of any article, machine, equipment, or contrivance which had a valid permit to operate within the two-year period immediately preceding the application is a temporary permit to operate. Issuance of the final permit to operate shall be conditional upon a determination by the district that the criteria specified in subdivisions (b) and (e) are met, if the permit was not surrendered as a condition to receiving emission reduction credits pursuant to banking or permitting rules of the district. However, under no circumstances shall the criteria specify that a change of ownership or operator alone is a basis for requiring more stringent emission controls or operating conditions than would otherwise apply to the article, machine, equipment, or contrivance.

42303 INFORMATION DISCLOSURE

An air pollution control officer, at any time, may require from an applicant for, or the holder of, any permit provided for by the regulations of the district board, such information, analyses, plans, or specifications which will disclose the nature, extent, quantity, or degree of air contaminants which are, or may be, discharged by the source for which the permit was issued or applied.

42303.5 FALSE STATEMENTS

No person shall knowingly make any false statement in any application for a permit, or in any information, analyses, plans, or specifications submitted in conjunction with the application or at the request of the air pollution control officer.

42304 FAILURE TO SUPPLY INFORMATION

If, within a reasonable time, the holder of any permit issued by a district board willfully fails and refuses to furnish the information, analyses, plans, or specifications requested by the district air pollution control officer, such officer may suspend the permit. Such officer shall serve notice in writing of such suspension and the reasons therefor on the permittee.

42350 APPLICATIONS FOR VARIANCE

(a) Any person may apply to the hearing board for a variance from Section 41701 or from the rules and regulations of the district.

(b) (1) If the district board has established a permit system by regulation pursuant to Section 42300, a variance, or an abatement order which has the effect of a variance, may not be granted from the requirement for a permit to build, erect, alter, or replace.

(2) Title V sources shall not be granted a variance, or an abatement order which has the effect of a variance, from the requirement for a permit to operate or use.

(3) In districts with emission-capped trading programs, no variance shall be granted from the emission cap requirement.

42351 INTERIM VARIANCE APPLICATIONS

(a) Any person who has submitted an application for a variance and who desires to commence or continue operation pending the decision of the hearing board on the application, may submit an application for an interim variance.

(b) An interim variance may be granted for good causes stated in the order granting such a variance. The interim variance shall not be valid beyond the date of decision of the hearing board on the application of the variance or for more than 90 days from date of issuance of the interim variance, whichever occurs first.

(c) The hearing board shall not grant any interim variance (1) after it has held a hearing in compliance with the requirements of Section 40826, or (2) which is

being sought to avoid the notice and hearing requirements of Section 40826.

42351.5 INTERIM SCHEDULE MODIFICATION

If a person granted a variance with a schedule of increments of progress files an application for modification of the schedule and is unable to notify the hearing board sufficiently in advance to allow the hearing board to schedule a public hearing on the application, the hearing board may grant no more than one interim authorization valid for not more than 30 days, to that person to continue operation pending the decision of the hearing board on the application. In districts with a population of less than 750,000, the chairman of the hearing board or any other member designated by the board may hear the application. If any member of the public contests such a decision made by a single member of the hearing board, the application shall be reheard by the full hearing board within 10 days of the decision. The interim authorization shall not be granted for a requested extension of a final compliance date or where the original variance expressly required advance application for the modification of an increment of progress.

42352 VARIANCE ISSUANCE REQUIREMENTS

(a) No variance shall be granted unless the hearing board makes all of the following findings:

(1) That the petitioner for a variance is, or will be, in violation of Section 41701 or of any rule, regulation, or order of the district.

(2) That, due to conditions beyond the reasonable control of the petitioner, requiring compliance would result in either (A) an arbitrary or unreasonable taking of property, or (B) the practical closing and elimination of a lawful business. In making those findings where the petitioner is a public agency, the hearing board shall consider whether or not requiring immediate compliance would impose an unreasonable burden upon an essential public service. For purposes of this paragraph, "essential public service" means a prison, detention facility, police or fire fighting facility, school, health care facility, landfill gas control or processing facility, sewage treatment works, or water delivery operation, if owned and operated by a public agency.

(3) That the closing or taking would be without a corresponding benefit in reducing air contaminants.

(4) That the applicant for the variance has given consideration to curtailing operations of the source in lieu of obtaining a variance.

(5) During the period the variance is in effect, that the applicant will reduce excess emissions to the maximum extent feasible.

(6) During the period the variance is in effect, that the applicant will monitor or otherwise quantify emission levels from the source, if requested to do so by the district, and report these emission levels to the district pursuant to a schedule established by the district.

(b) As used in this section, "public agency" means any state agency, board, or commission, any county, city and county, city, regional agency, public district, or other political subdivision.

42353 OTHER REQUIREMENTS

Upon making the specific findings set forth in Section 42352, the hearing board shall prescribe requirements other than those imposed by statute or by any rule, regulation, or order of the district board, not more onerous, applicable to plants and equipment operated by specified industry or business or for specified activity, or to the operations of individual persons. However, no variance shall be granted if the operator, under the variance, will result in a violation of Section 41700.

42354 PRESCRIBING REQUIREMENTS

In prescribing other and different requirements, in accordance with Section 42353, the hearing board, insofar as is consonant with the Legislature's declarations in Sections 39000 and 39001, shall exercise a wide discretion in weighing the equities involved and the advantages to the residents of the district from the reduction of air contaminants and the disadvantages to any otherwise lawful business, occupation, or activity involved, resulting from requiring compliance with such requirements.

42355 HEARING BOARD BOND REQUIREMENTS

(a) The hearing board may require, as a condition of granting a variance, that a bond be posted by the party to whom the variance was granted to assure performance of any construction, alteration, repair, or other work required by the terms and conditions of the variance. The bond may provide that, if the party granted the variance fails to perform the work by the agreed date, the bond shall be forfeited to the district having jurisdiction, or the sureties shall have the option of promptly remedying the variance default or paying to the district an amount, up to the amount specified in the bond, that is necessary to accomplish the work specified as a condition of the variance.

(b) The provisions of this section do not apply to vessels so long as the vessels are not operating in violation of any federal law enacted for the purpose of controlling emissions from combustion of vessel fuels.

42356 HEARING BOARD VARIANCE MODIFICATION

The hearing board may modify or revoke, by written order, any order permitting a variance.

42357 HEARING BOARD REVIEW OF SCHEDULE

The hearing board may review and for good cause, such as a change in the availability of materials, equipment, or adequate technology, modify a schedule of increments of progress or a final compliance date in such a schedule.

42358 EFFECTIVE PERIOD OF ORDER

(a) The hearing board, in making any order permitting a variance, shall specify the time during which such order shall be effective, in no event, except as otherwise provided in subdivision (b), to exceed one year, and shall set a final compliance date.

(b) A variance may be issued for a period exceeding one year if the variance includes a schedule of increments of progress specifying a final compliance date by which the emissions of air contaminants of a source for which the variance is granted will be brought into compliance with applicable emission standards.

42359 PUBLIC HEARING REQUIREMENTS

Except in the case of an emergency, as determined by the hearing board, the hearing board shall hold a hearing pursuant to Chapter 8 (commencing with Section 40800) of Part 3 to determine under what conditions, and to what extent, a variance shall be granted.

42359.5 EMERGENCY VARIANCES

(a) Notwithstanding any other provision of this article or of Article 2 (commencing with Section 40820) of Chapter 8 of Part 3, the Chairman of a district hearing board, or any other member of the hearing board designated thereby, may issue, without notice and hearing, an emergency variance to an applicant.

(b) An emergency variance may be issued for good cause, including, but not limited to, a breakdown condition. The district board in consultation with its air pollution control officer and the hearing board may adopt rules and regulations, not inconsistent with this subdivision, to further specify the conditions, and to what extent, an emergency variance may be granted.

The emergency variance shall not remain in effect longer than 30 days and shall not be granted when sought to avoid the provisions of Section 40824 or 42351.

42360 COPY OF VARIANCE ORDER TO ARB

Within 30 days of any order granting, modifying, or otherwise affecting a variance by the hearing board, or a member thereof pursuant to Section 42359.5, either the air pollution control officer or the hearing board shall submit a copy of the order to the state board.

42361 VALIDITY OF VARIANCE TIME

Any variance granted by the hearing board of a county district or a unified district, or any member of such a hearing board pursuant to Section 42359.5, applicable in an area which subsequently becomes included within a regional district, including the bay district, shall remain valid for the time specified therein or for one year, whichever is shorter, or, unless prior to the expiration of

such time, the hearing board of the regional district modifies or revokes the variance.

42362 VARIANCE REVOCATION OR MODIFICATION

The state board may revoke or modify any variance granted by any district if, in its judgement, the variance does not require compliance with a required schedule of increments of progress or emission standards as expeditiously as practicable, or the variance does not meet the requirements of this article.

42363 ARB HEARING PRIOR TO ACTION

Prior to revoking or modifying a variance pursuant to Section 42362, the state board shall conduct a hearing pursuant to Chapter 8 (commencing with Section 40800) of Part 3 on the matter. The person to whom the variance was granted shall be given immediate notice of any such hearing by the hearing board, and shall be afforded an opportunity to appear at the hearing, to call and examine witnesses, and to otherwise partake as if he were a party to the hearing.

42364 SCHEDULE OF FEES

(a) The district board may adopt, by regulation, a schedule of fees which will yield a sum not exceeding the estimated cost of the administration of this article and for the filing of applications for variances or to revoke or modify variances. All applicants shall pay the fees required by the schedule, including, notwithstanding the provisions of Section 6103 of the Government Code, an applicant that is a publicly owned public utility.

(b) All such fees shall be paid to the district treasurer to the credit of the district.

42400 GENERAL VIOLATIONS, CRIMINAL

(a) Except as otherwise provided in Section 42400.1, 42400.2, or 42400.3, or 42400.4 who violates this part, or any rule, regulation, permit, or order of the state board or of a district, including a district hearing board, adopted pursuant to Part 1 (commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, is guilty of a misdemeanor and is subject to a fine of not more

than one thousand dollars ($1,000) or imprisonment in the county jail for not more than six months, or both.

(b) If a violation under subdivision (a) with regard to the failure to operate a vapor recovery system on a gasoline cargo tank is directly caused by the actions of an employee under the supervision of, or of any independent contractor working for, any person subject to this part, the employee or independent contractor, as the case may be, causing the violation is guilty of a misdemeanor and is punishable as provided in subdivision (a). That liability shall not extend to the person employing the employee or retaining the independent contractor, unless that person is separately guilty of an action that violates this part.

(c) (1) Any person who knowingly violates any rule, regulation, permit, order, fee requirement, or filing requirement of the state board or of a district, including a district hearing board, that is adopted for the control of toxic air contaminants pursuant to Part 1 (commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, and for which delegation or approval of implementation and enforcement authority has been obtained pursuant to subdivision (l) of Section 112 of the Clean Air Act (42 U.S.C. Sec. 7412(l)), or the regulations adopted pursuant thereto, is guilty of a misdemeanor and is subject to a fine of not more than ten thousand dollars ($10,000) or imprisonment in the county jail for not more than six months, or both.

(2) Any person who knowingly makes any false material statement, representation, or certification in any form or in any notice or report required by a rule or regulation adopted or permit issued for the control of toxic air contaminants pursuant to Part 1 (commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, and for which delegation or approval of implementation and enforcement authority has been obtained pursuant to subdivision (l) of Section 112 of the Clean Air Act (42 U.S.C. Sec. 7412(l)), or the regulations adopted pursuant thereto, or who knowingly renders inaccurate any monitoring device required by that toxic air contaminant rule, regulation, or permit is guilty of a misdemeanor and is subject to a fine of not more than ten thousand dollars ($10,000) or imprisonment in the county jail for not more than six months, or both.

(3) Paragraphs (1) and (2) apply only to violations that are not otherwise subject to a fine of ten thousand dollars ($10,000) or more pursuant to Section 42400.1, 42400.2, or 42400.3.

(d) The recovery of civil penalties pursuant to Section 42402, 42402.1, 42402.2, or 42402.3 precludes prosecution pursuant to this section for the same offense. When a district refers a violation to a prosecuting agency, the filing of a criminal complaint is grounds requiring the dismissal of any civil action brought pursuant to this article for the same offense.

(e) Each day during any portion of which a violation of subdivision (a) or (c) occurs is a separate offense.

42400.1 NEGLIGENCE, CRIMINAL

(a) Any person who negligently emits an air contaminant in violation of any provision of this part or any rule, regulation, permit, or order of the state board or of a district pertaining to emission regulations or limitations is guilty of a misdemeanor and is subject to a fine of not more than fifteen thousand dollars ($15,000) or imprisonment in the county jail for not more than nine months, or both.

(b) Any person who owns or operates any source of air contaminant in violation of Section 41700 which causes actual injury, as defined in paragraph (2) of subdivision (d) of Section 42400.2, to the health or safety of a considerable number of persons or the public is guilty of a misdemeanor and is punishable as provided in subdivision (a).

(c) Each day during any portion of which a violation occurs is a separate offense.

(d) The recovery of civil penalties pursuant to Section 42402, 42402.1, 42402.2, or 42402.3, precludes prosecution pursuant to this section for the same offense. When a district refers a violation to a prosecuting agency, the filing of a criminal complaint is grounds requiring the dismissal of any civil action brought pursuant to this article for the same offense.

42400.2 DOCUMENT FALSIFICATION, CRIMINAL

(a) Any person who emits an air contaminant in violation of any provision of this part, or any order, rule, regulation, or permit of the state board or of a district pertaining to emission regulations or limitations, and who knew of the emission and failed to take corrective action within a reasonable period of time

under the circumstances, is guilty of a misdemeanor and is subject to a fine of not more than twenty-five thousand dollars ($25,000) or imprisonment in the county jail for not more than one year, or both.

(b) For purposes of this section, "corrective action" means the termination of the emission violation or the grant of a variance from the applicable order, rule, regulation, or permit pursuant to Article 2 (commencing with Section 42350). If a district regulation regarding process upsets or equipment breakdowns would allow continued operation of equipment which is emitting air contaminants in excess of allowable limits, compliance with that regulation is deemed to be corrective action.

(c) Any person who, knowingly and with intent to deceive, falsifies any document required to be kept pursuant to any provision of this part, or any rule, regulation, permit, notice to comply, or order of the state board or of a district, is guilty of a misdemeanor and is punishable as provided in subdivision (a).

(d) (1) Any person who owns or operates any source of air contaminants in violation of Section 41700 which causes actual injury to the health or safety of a considerable number of persons or the public, and who knew of the emission and failed to take corrective action within a reasonable period of time under the circumstances, is guilty of a misdemeanor and is punishable as provided in subdivision (a).

(2) As used in this subdivision, "actual injury" means any physical injury which, in the opinion of a licensed physician and surgeon, requires medical treatment involving more than a physical examination.

(e) Each day during any portion of which a violation occurs constitutes a separate offense.

(f) The recovery of civil penalties pursuant to Section 42402, 42402.1, 42402.2, or 42402.3 precludes prosecution pursuant to this section for the same offense. When a district refers a violation to a prosecuting agency, the filing of a criminal complaint is grounds requiring the dismissal of any civil action brought pursuant to this article for the same offense.

42400.3 WILLFULLY EMITTING AN AIR CONTAMINANT

(a) Any person who willfully and intentionally emits an air contaminant in violation of any provision of this part or any rule, regulation, permit, or order of the state board or of a district, pertaining to emission regulations or limitations is guilty of a misdemeanor and is subject to a fine of not more than fifty thousand dollars ($50,000) or imprisonment in the county jail for not more than one year, or both.

(b) The recovery of civil penalties pursuant to Section 42402, 42402.1, 42402.2 or 42402.3 precludes prosecution pursuant to this section for the same offense. When a district refers a violation to a prosecuting agency, the filing of a criminal complaint is grounds requiring the dismissal of any civil action brought pursuant to this article for the same offense. (c) Each day during any portion of which a violation occurs constitutes a separate offense.

42401 VIOLATING ORDER OF ABATEMENT, CIVIL

Any person who intentionally or negligently violates any order of abatement issued by a district pursuant to Section 42450, by a hearing board pursuant to Section 42451, or by the state board pursuant to Section 41505 is liable for a civil penalty of not more than twenty-five thousand dollars ($25,000) for each day in which the violation occurs.

42402 GENERAL VIOLATIONS, CIVIL

(a) Except as otherwise provided in subdivision (b) or in Section 42402.1, 42402.2, or 42402.3, any person who violates this part, any order issued pursuant to Section 42316, or any rule, regulation, permit, or order of a district, including a district hearing board, or of the state board issued pursuant to Part 1 (commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, is strictly liable for a civil penalty of not more than one thousand dollars ($1,000).

(b) (1) Any person who violates any provision of this part, any order issued pursuant to Section 42316, or any rule, regulation, permit, or order of a district, including a district hearing board, or of the state board issued pursuant to Part 1

(commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, is strictly liable for a civil penalty of not more than ten thousand dollars ($10,000).

(2) (A) If a civil penalty in excess of one thousand dollars ($1,000) for each day in which the violation occurs is sought, there is no liability under this subdivision if the person accused of the violation alleges by affirmative defense and establishes that the violation was caused by an act which was not the result of intentional or negligent conduct.

(B) Subparagraph (A) does not apply to a violation of federally enforceable requirements that occur at a Title V source in a district in which a Title V permit program has been fully approved.

(C) Subparagraph (A) does not apply to a person who is determined to have violated an annual facility emissions cap established pursuant to a market-based incentive program adopted by a district pursuant to subdivision (b) of Section 39616.

(c) Each day during any portion of which a violation occurs is a separate offense.

42402.1 NEGLIGENCE OR ACTUAL INJURY, CIVIL

(a) Any person who negligently emits an air contaminant in violation of this part or any rule, regulation, permit, or order of the state board or of a district pertaining to emission regulations or limitations is liable for a civil penalty of not more than fifteen thousand dollars ($15,000).

(b) Any person who owns or operates any source of air contaminants in violation of Section 41700 which causes actual injury, as defined in paragraph (2) of subdivision (d) of Section 42400.2, to the health or safety of a considerable number of persons or the public is liable for a civil penalty as provided in subdivision (a).

(c) Each day during any portion of which a violation occurs is a separate offense.

42402.2 DOCUMENT FALSIFICATION, CIVIL

(a) Any person who emits an air contaminant in violation of any provision of this part, or any order, rule, regulation, or permit of the state board or of a district pertaining to emission regulations or limitations, and who knew of the emission and failed to take corrective action, as defined in subdivision (b) of Section 42400.2, within a reasonable period of time under the circumstances, is liable for a civil penalty, of not more than twenty-five thousand dollars ($25,000).

(b) Any person who, knowingly and with intent to deceive, falsifies any document required to be kept pursuant to any provision of this part, or any rule, regulation, permit, or order of the state board or of a district, is subject to the same civil penalty as provided in subdivision (a).

(c) Any person who owns or operates any source of air contaminants in violation of Section 41700 which causes actual injury, as defined in paragraph (2) of subdivision (d) of Section 42400.2, to the health or safety of a considerable number of persons or the public, and who knew of the emission and failed to take corrective action, as defined in subdivision (b), of Section 42400.2, within a reasonable period of time under the circumstances, is subject to a civil penalty as provided in subdivision (a).

(d) Each day during any portion of which a violation occurs is a separate offense.

42402.3 CIVIL PENALTIES

Any person who willfully and intentionally emits an air contaminant in violation of any provision of this part or any order, permit, rule, or regulation of the state board, or of a district, pertaining to emission regulations or limitations, is liable for a civil penalty of not more than fifty thousand dollars ($50,000).

42402.5 ADMINISTRATIVE PENALTIES

In addition to any civil and criminal penalties prescribed under this article, a district may impose administrative civil penalties for a violation of this part, or

any order, permit, rule, or regulation of the state board or of a district, including a district hearing board, adopted pursuant to Part 1 (commencing with Section 39000) to Part 4 (commencing with Section 41500), inclusive, if the district board has adopted rules and regulations specifying procedures for the imposition and amounts of these penalties. No administrative civil penalty levied pursuant to this section may exceed five hundred dollars ($500) for each violation. However, nothing in this section is intended to restrict the authority of a district to negotiate mutual settlements under any other penalty provisions of law which exceeds five hundred dollars ($500).

42403 RECOVERY OF CIVIL PENALTIES

(a) The civil penalties prescribed in Sections 39674, 42401, 42402, 42402.1, 42402.2, and 42402.3 shall be assessed and recovered in a civil action brought in the name of the people of the State of California by the Attorney General, by any district attorney, or by the attorney for any district in which the violation occurs in any court of competent jurisdiction.
(b) In determining the amount assessed, the court, or in reaching any settlement, the district, shall take into consideration all relevant circumstances, including, but not limited to, the following:

(1) The extent of harm caused by the violation.

(2) The nature and persistence of the violation.

(3) The length of time over which the violation occurs.

(4) The frequency of past violations.

(5) The record of maintenance.

(6) The unproven or innovative nature of the control equipment.

(7) Any action taken by the defendant, including the nature, extent, and time of response of the cleanup and construction undertaken, to mitigate the violation.

(8) The financial burden to the defendant.

42404.5 STATUTE OF LIMITATIONS FOR CIVIL ACTIONS

Any limitation of time applicable to actions brought pursuant to Section 42403 shall not commence to run until the offense has been discovered, or could reasonably have been discovered.

42450 ORDERS OF ABATEMENT

The district board may, after notice and a hearing, issue an order for abatement whenever it finds that any person is constructing or operating any article, machine, equipment, or other contrivance without a permit required by this part, or is in violation of Section 41700 or 41701 or of any order, rule, or regulation prohibiting or limiting the discharge of air contaminants into the air.

In holding such a hearing, the district board shall be vested with all the powers and duties of the hearing board. Notice shall be given, and the hearing shall be held, pursuant to Chapter 8 (commencing with Section 40800) of Part 3.

42700 MONITORING DEVICES

(a) The Legislature hereby finds and declares that stationary sources of air pollution are known to emit significant amounts of pollutants into the air, but that existing sampling techniques are not sufficiently precise to permit accurate measurement. The Legislature further finds and declares that more accurate data will improve the design of strategies for the control of pollutants in the most cost-effective manner.

(b) The Legislature further finds and declares that public complaints about excessive emissions from stationary sources are difficult or impossible to evaluate in the absence of adequate means of monitoring emissions on a continuing basis. The Legislature further finds and declares that, although the state board and the districts are authorized under Sections 41511 and 42303 to require stationary sources of air contaminants to install and operate monitoring devices to measure and record continuously the emissions concentration and amount of any specified pollutant, many districts have failed to exercise that authority.

(c) The Legislature further finds and declares that all districts, especially the bay district, the districts located, in whole or part, within the South Coast Air Basin, and the San Diego County Air Pollution Control District, should be encouraged to require that monitoring devices be installed in each stationary source of air contaminants that emits into the atmosphere 100 tons or more each year of nonmethane hydrocarbons, oxides of nitrogen, oxides of sulfur, reduced sulfur compounds, or particulate matter or 1,000 tons or more each year of carbon monoxide.

(d) The Legislature further finds and declares that, pursuant to Section 39616, the south coast district has required the installation of a substantial number of monitoring devices and the installation and use of strip chart recorders for compliance purposes. However, electronic or computer data capture and storage is generally less costly and may have the capability to provide greater data availability with the same degree of security.
(e) To encourage the districts to take actions to monitor emissions of stationary sources as described in this section, the state board shall determine the availability, technological feasibility, and economic reasonableness of monitoring devices for those stationary sources as provided by Section 42701.

(f) To make emissions data available to the public and to minimize burdens on the private sector, the districts shall allow stationary sources the option of using electronic or computer data storage for purposes of compliance with Section 39616.

42701 AVAILABILITY, FEASIBILITY

(a) For the purposes of Sections 41511 and 42303, the state board shall determine the availability, technological feasibility, and economic reasonableness of monitoring devices to measure and record continuously the emissions concentration and amount of nonmethane hydrocarbons, oxides of nitrogen, oxides of sulfur, reduced sulfur compounds, particulate matter, and carbon monoxide emitted by stationary sources. Such determination shall be made for stationary sources which emit such contaminants in the quantities set forth in Section 42700, and may be made for stationary sources which emit lesser amounts. The state board shall complete an initial review of submitted devices by June 1, 1975.

42702 SPECIFICATION OF PROCESSES

The state board shall specify the types of stationary sources, processes, and the contaminants, or combinations thereof, for which a monitoring device is available, technologically feasible, and economically reasonable. Such specification may be by any technologically based classification, including on an industry-wide basis or by individual stationary source, by air basin, by district, or any other reasonable classification.

42703 REIMBURSEMENTS FOR TESTING EXPENSES

The state board shall require the manufacturer of any monitoring device submitted for a determination to reimburse the state board for its actual expenses incurred in making the determination, including, where applicable, its contract expenses for testing and review.

42704 DETERMINATION OF AVAILABILITY

After the state board has made a determination of availability, the state board may, as appropriate, revoke or modify its prior determination of availability if circumstances beyond the control of the state board, or of a stationary source required to install a monitoring device, cause a substantial delay or impairment in the availability of the device or cause the device no longer to be available.

42705 RECORDS

Any stationary source required by the district in which the source is located to install and operate a monitoring device shall retain the records from the device for not less than two years and, upon request, shall make the records available to the state board and the district. The district shall allow the source the option of using electronic or computer data storage, as defined in Section 40407.5 and consistent with Section 40440.3, as a method of record retention. The source shall not be limited solely to the installation or maintenance of strip chart recorders.

42706 REPORT OF VIOLATION

Any violation of any emission standard to which the stationary source is required to conform, as indicated by the records of the monitoring device, shall be reported by the operator of the source to the district within 96 hours after such occurrence. The district shall, in turn, report the violation to the state board within five working days after receiving the report of the violation from the operator.

42707 INSPECTION; FEES

The air pollution control officer shall inspect, as he determines necessary, the monitoring devices installed in every stationary source of air contaminants located within his jurisdiction required to have such devices to insure that such devices are functioning properly. The district may require reasonable fees to be paid by the operator of any such source to cover the expense of such inspection and other costs related thereto.

42708 POWERS OF LOCAL OR REGIONAL AUTHORITY

This chapter shall not prevent any local or regional authority from adopting monitoring requirements more stringent than those set forth in this chapter or be construed as requiring the installation of monitoring devices on any stationary source or classes of stationary sources. This section shall not limit the authority of the state board to require the installation of monitoring devices pursuant to Chapter 1 (commencing with Section 41500).

APCD/AQMD Prohibitory Rules

Each local APCD/AQMD has prohibitory rules that govern basic operations of any stationary source that emit air pollutants. The majority of printed circuit board shops are located in the Bay Area Air Quality Management District (BAAQMD), the San Diego Air Pollution Control District (SDCAPCD), the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), the South Coast Air Quality Management District (SCAQMD), and the Ventura County Air Pollution Control District (VCAPCD). Therefore, only these district rules affecting the printed circuit board industry are discussed in detail in the following sections.

601 ENFORCEMENT

Permit to Operate

After a Permit to Operate is issued, the APCD/AQMD or (district) enforcement staff will inspect the facility periodically to determine compliance. A significant portion of the compliance determination is usually based on comparing operating conditions included in the Permit to Operate with the status of the permitted equipment. Permits have conditions which help ensure compliance with district rules and regulations.

Civil and Criminal Penalties

District enforcement staff may also perform a source test to determine compliance with emission limits. Rule violations documented by enforcement staff either by source test or other means may be subject to civil and criminal penalties and fines up to $50,000 per day. A criminal violation could result in imprisonment for up to one year.

602 SUMMARY OF BAAQMD RULE AND PERMIT REQUIREMENT

BAAQMD Permit Handbook

BAAQMD has published a Permit Handbook, Chapter 39, Printed Circuit Board Manufacturing Operations, which addresses permit issues in the Bay Area. This document is available through the district.

603 SUMMARY OF SCAQMD RULE AND PERMIT REQUIREMENTS

SCAQMD Regulations

There are no rules specific to the printed circuit board manufacturing industry in SCAQMD regulations.

Rules 201 and Rule 203, Permit Requirements. Permits are required unless the equipment is exempted in Rule 219. However, if the material is processed in a continuous line, then all equipment in the line is included in the permit. This most

Permit Requirements

commonly occurs in the plating or etching operations where rinse or alkaline surface prep tanks are listed on the plating or etching tank permit.

Nuisance

Rule 402, Nuisance. The most likely source of a nuisance are etchers using ammonia. There could also could be a problem with nuisance from the acids used. Most sources using any quantity of acid or ammonia have scrubbers.

2000 ppm CO

Rule 407, 2000 ppm CO. The plasma arc cutting of circuit boards can cause concentrations of near 2000 ppm CO.

Source Specific Rules

Reg XI, Source Specific Rules. There are no source specific rules for printed circuit boards. Some of the Reg XI coating rules will apply depending on the process.

BACT and Offsets

Reg XIII, BACT and Offsets. In essence, if the equipment emits more than 1 lb/day of any air contaminant, BACT and offsets are required. Most permit units have emissions less than 1 lb/day. A BACT evaluation requires an evaluation of what is achieved in practice or what is cost effective. Scrubbers are installed for acid and ammonia emissions. Carbon adsorbers or afterburners are used for VOCs. Offsets are not required if the potential to emit for the facility is less than 4 tons/yr. Very few sources, if any, have needed emission reduction credits (ERCs) for offsets.

District Rules and Regulations

Permit conditions are placed on permits to assure that the equipment permitted will operate in compliance with District Rules and Regulations. Because there are no rules that specifically apply to printed circuit board manufacturing, most conditions are of a general nature. They limit emissions used for offsets through limits on the process, such as gallons of material used or hours operated. They require proper use of control equipment, such as pH reading or the temperature of an afterburner. Conditions require monitoring and record keeping to prove compliance with process limits or proper use of control equipment.

Emissions are calculated using mass balances or emission factors. Some emission factors used are:

VOC emissions are usually calculated on a mass balance basis. VOC in equals VOC out.
Ammonia emissions are considered particulate matter precursors and are offset as particulates. Ammonia emissions from etching are calculated to be 8 lb pm/55 gallons ammonia used.

Emissions from open process tanks with no rectifiers are calculated from emission

factors specific to the materials used, usually in terms of lb pm/sq. ft open surface area.

Emissions from tanks with rectifiers are calculated from emission factors based on amperage used.

Wave soldering emissions are calculated from the oil and flux usage. It is assumed that 25% of the oil is emitted as particulate matter and 20% of the flux is emitted as VOC.

Solder reflow emissions assume that 80% of the oil is lost due to drag-out and 20% is emitted as PM.

604 SUMMARY OF VCAPCD RULE AND PERMIT REQUIREMENTS

District Rule 74.21, Semiconductor Manufacturing, applies narrowly to operations performed in the manufacture of semiconductor materials, and excludes operations related to the manufacture and assembly of printed circuit boards.

Draft Rule 74.32, Electronic Manufacturing and Assembly Operations, will cover some operations related to the manufacture and assembly of printed circuit boards.

Rule 74.6, Surface Cleaning and Degreasing, allows the cleaning of electronic components using solvents with a ROC composite partial pressure of 33 mm Hg @ 20 degrees C or less and a ROC content of 900 g/l or less. The use of isopropyl alcohol is deemed in compliance with this requirement. Additional solvent cleaning requirements (e.g., cleaning methods, control equipment, record keeping) specified in the rule apply to the manufacture and assembly of printed circuit boards.

Rule 74.6, Graphic Arts, exempts the manufacturing of printed circuit board operations. Rule 74.19.1, Screen Printing Operations, exempts the manufacturing of printed circuit boards. In general, Rule 50, Opacity, and Rule 51, Nuisance, apply to all operations, even if exempt from permit.

VCAPCD has a permitting policy regarding increases in emissions of toxic air pollutants from new, modified replacement or relocated emission units. The policy states

Ammonia Emissions

Emission Factors

Wave Soldering Emissions

Solder Reflow Emissions

Semiconductor Manufacturing

Electronic Manufacturing/ Assembly Operations

Surface Cleaning and Degreasing

that, as part of the permitting process, an emissions unit with an increase in emissions of toxic air pollutants would be subject to health risk screening or health risk assessment requirements if the threshold limits are exceeded (refer to Appendix C for VCAPCD policy memo). Only increases in toxic air pollutants are to be considered.

Health Risk Screening or Health Risk Assessment

605 SHEARING

Process Description: Cutting cores to size.

Shearing

Figure 605.1
Shearing

605.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation 2, Rule 1, Section 125.1.2.

605.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There can be emissions from cutting/shearing of fiberglass, and some of the equipment in the District is vented to baghouses. Equipment and control equipment (baghouse) are exempt from permit requirements per Rule 219(g)(1).

605.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Source is exempt as long as shearing does not abrade the printed circuit board.

605.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be subject to permits dependent upon uncontrolled emissions.

605.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23.B.4.

606 CORE PREPARATION

Cores are Passed Through a Cleaning Solution

Process Description: Cores are passed through a cleaning solution to promote adhesion of the resist.

Figure 606.1
Core Preparation

606.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 118.4 or 118.5.

Compliance Determination: The materials used at these sources typically do not contain any volatile organic compounds or emit toxic air contaminants in excess of the trigger levels.

606.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: These mechanical cleaning and alkaline surface preparation

operations are exempt from permit requirement per Rule 219(g) (1) and 219(1)(4).

606.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Exempt if cleaning solution is aqueous based (less than 10% VOC by weight). Rule 11(d)(16)

Toxics: If cleaning solution contains toxics 10% by weight, permits are required for the equipment.

Permit Conditions: Reflect Requirements of District Rule 67.6.

Regulations: Rule 67.6.

606.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: for VOC or HAP emissions, may include: throughput, daily emissions limits (DELs), VOC content limits for coatings.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

606.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23.F.10.a or 23.I.9.

Regulations: This source is subject to Regulation IV, Rule 74.6, Solvent Cleaning & Degreasing, and as appropriate, Rules 74.6.1, 74.6.2, or 74.6.3.

607 DRY FILM PHOTO RESIST APPLICATION

Dry Film Photo Resist Application

Process Description: Dry film applied to a copper clad core.

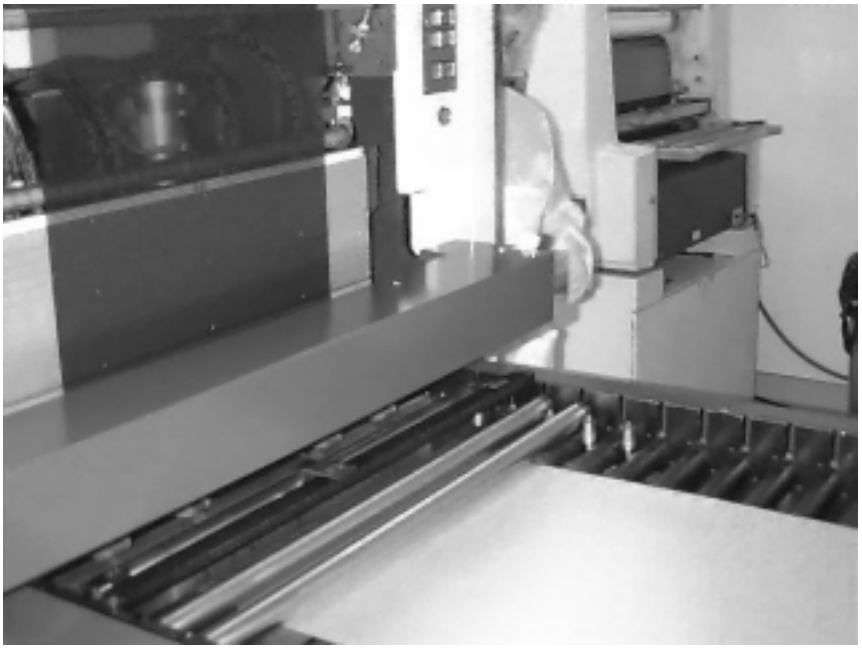


Figure 607.1
Dry Film Photo Resist Application

607.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 119.2.2, even though toxic air contaminants may be emitted. See Compliance Determination section below.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: This is a coating source. Currently, all dry film photo resist operations are expected to comply with the 5 ton VOC limit (8-4-302.1). The dry film used at these sources typically emits 50 lb VOC per million square feet (mmft^2

) of film laminated; therefore, a source would exceed the 5 ton VOC limit only if it used more than 200 $mmft^2$ of film. In 1997, no facility in the District approached these amounts. Dry film resists now used in the industry emit toxic air contaminants, but not in such quantities necessary to require a risk screen analysis and Permit to Operate. Toxics would be an issue only if a facility uses approximately 126 $mmft^2$ of film. In 1997, no facility approached these limits. Records are required by Regulation 8, Rule 4.

607.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt from permit requirement per Rule 219(h)(1). Some of the larger units have permits because emissions are greater than 3 lb/day VOC.

607.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

607.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Conditions: Permit conditions for processes which may emit particulate matter may include: visible emissions standards, throughput, disposal of collected material. Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts, Rule 4661--Organic Solvents.

607.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.11.b.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Comments: Assume this is a lamination process with a low VOC content, that would produce less than 200 lbs each of ROC, methylene Chloride, 1,1,1-trichloroethane, and perchloroethylene during any rolling period of 12 consecutive calendar months.

608 NEGATIVE IMAGE EXPOSURE

Process Description: The area outside the desired image is exposed to UV light.

The Area Outside the Desired Image is Exposed to UV Light.

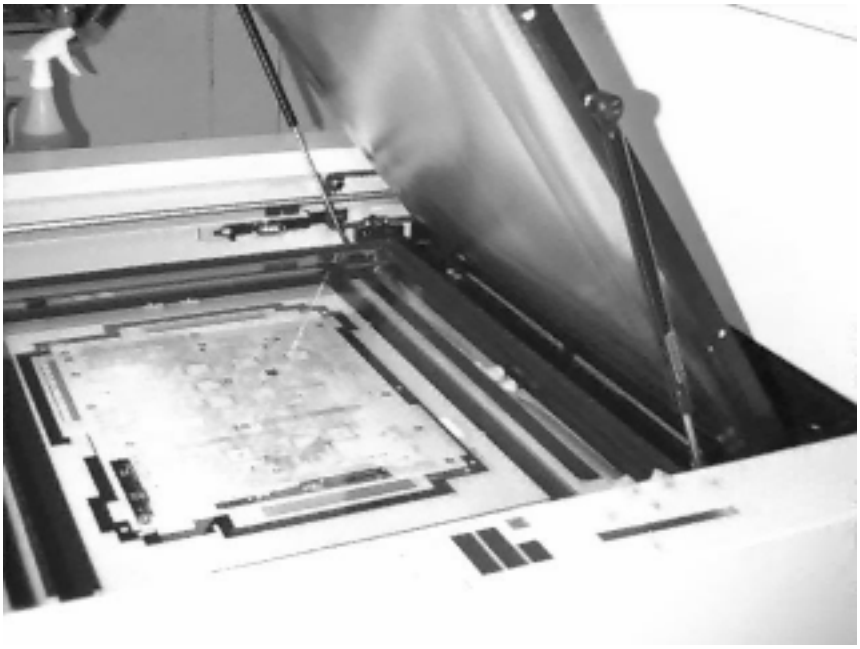


Figure 608.1
Negative Image Exposure

608.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 127.2.

Compliance Determination: None. These sources do not emit any significant amounts of volatile organic compounds or emit toxic air contaminants in excess of the trigger levels.

608.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There are slight VOC emissions from the curing of the coating, but they are exempt from permit requirement per Rule 219(h)(1) and 219(h)(2).

608.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

608.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be considered part of process of Dry Film Photo Resist Application.

608.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

609 DEVELOPER

Removes the Unexposed Photo Resist.

Process Description: Removes the unexposed photo resist.

Figure 609.1
Developer

609.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.5 or 103. Developers using heated solutions with a VOC content of less than 2.5% (wt) are exempt. Developers which are not exempt per Section 118.5 are exempt if VOC emissions are less than 10 pounds a day or less than 150 pounds a year.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing no organic compounds. Most inner layer developer solutions in the Bay Area use an aqueous potassium carbonate solution; therefore, after verifying there are no organics, no compliance determination is necessary.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118.5). These exempt sources, in the District's current inventory, are typically 5 tons VOC (8-4-302).

3. Those containing organic compounds with concentrations >2.5% VOC and emitting <10 lb VOC per day (2-1-103). These exempt sources comply with the 5 ton limit in Regulation 8, Rule 4.

4. Those containing organic compounds with concentrations >2.5% VOC and requiring a Permit to Operate. Throughput limits should be verified to determine compliance with the permit conditions. The permit conditions should reflect compliance with the 5 ton limit in Regulation 8, Rule 4. If the permit condition limits are exceeded the inspector should follow current enforcement policy.

NOTE: Developers may be grouped and conditioned as one source, combining the etcher and stripper sources. These sources together are referred to as the D.E.S. line. Developers in the District's current inventory are all using heated solutions. Records should be kept per Regulation 8 Rule 4 and District permit conditions, if applicable.

609.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source typically uses alkaline solutions and is therefore exempt from permit requirement per Rule 219(1)(4).

609.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

609.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

609.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: Regulation IV, Rule 74.6 could apply to the removal of uncured coatings, but the rule does not apply to cured coatings.

610 ETCHER

Process Description: Removes all unwanted copper from undesired image.

Removes all Unwanted Copper from Undesired Image

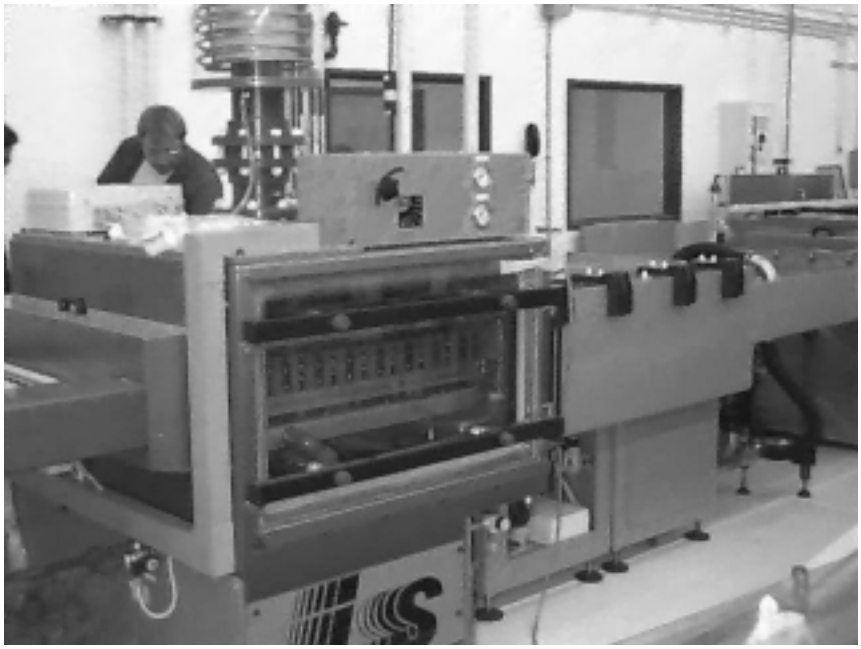


Figure 610.1
Etcher

610.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 127.4 or 103. Etchers using ammonia exceeding the toxic risk screening trigger level may require a Permit to Operate.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: Sources using caustic or acid etchants are not subject to Regulation 8, Rule 4. These sources can be odorous and may be subject to Regulation 7.

Compliance Determination: Generally, inner layer etchers use cupric chloride

solutions which are exempt from Permits to Operate. Throughput limits should be verified to determine compliance with the permit condition limits for permitted ammonia etchers.

NOTE: An Etcher may be grouped under one source number, combining the developer and stripping units. These sources together are referred to as the D.E.S. line. Records may be required by District permit conditions.

610.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Circuit board etchers and the control units (scrubbers) using ammonia based etchant require permits. Others are exempt from permit requirement per Rule 219 (1)(4).

610.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Etchers using ammonium hydroxide, ammonium chloride, or solutions of nitric, hydrofluoric and / or hydrochloric acids which contain more than 17% acid concentration by weight require a district permit.

Permit Conditions: Operational parameters to minimize odors and NOx emissions.

Regulations: No specific rule except public nuisance concerns.

610.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.
Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

610.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rules 23.F.15, or 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: May be subject to Regulation IV, Rule 51, Nuisance, if odorous.

611 PHOTO RESIST STRIPPER

The Stripper Removes the Polymerized Photo Resist Image

Process Description: The stripper removes the polymerized photo resist image.

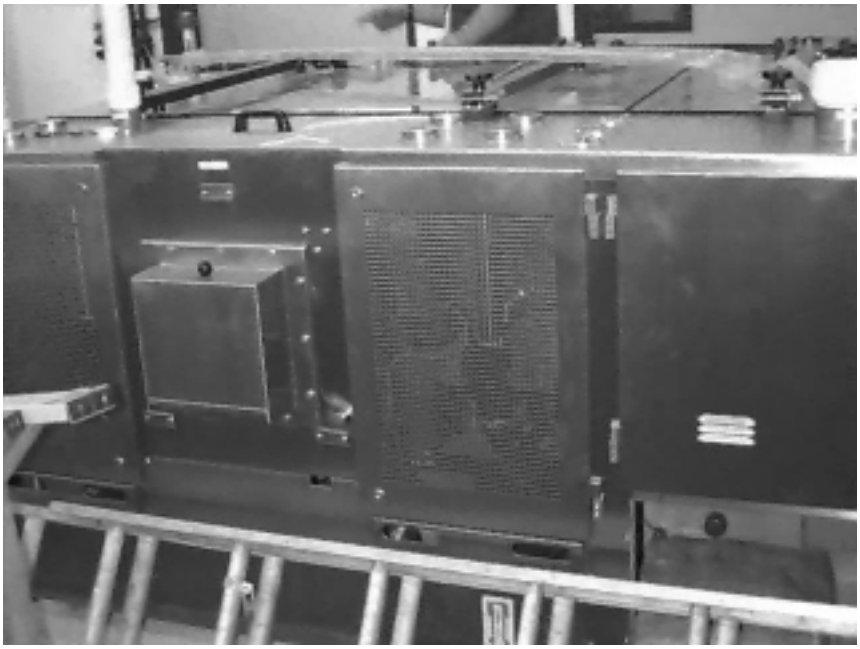


Figure 611.1
Photo Resist Stripper

611.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 118.5 or Section 103. Strippers using heated solutions with a VOC content of less than 2.5% (wt) are exempt. Strippers which are not exempt per Section 118.5 are exempt if VOC emissions are less than 10 pounds a day or less than 150 pounds a year.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing organic compounds with concentrations that are >2.5% VOC then the source requires a Permit to Operate. Throughput limits should be verified to determine compliance with permit conditions. The permit conditions should reflect compliance with the 5 ton limit in Regulation 8, Rule 4. If the permit condition limits are exceeded, the inspector should follow current enforcement policy.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118.5). These exempt sources in the District's current inventory are typically 5 ton VOC (8-4-302).

3. Those containing organic compounds with concentrations >2.5% VOC and emit <10 lb VOC per day (2-1-103). These exempt sources comply with the 5 ton limit in Regulation 8, Rule 4.

NOTE: Strippers may be grouped and conditioned as one source, combining the developer and etcher sources. These sources together are referred to as the D.E.S. line. Strippers in the District's current inventory are all using heated solutions. Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

611.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Since most strippers use VOCs (MEA, Glycol Ether) containing materials, if the VOC concentration is less than 20 gm/liter, then the equipment is exempt from permit requirement. Most are greater than that, and require permits.

611.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11. Strippers using solutions of VOCs less than 10% by weight are exempt.

Permit Conditions: Reflect requirements of Regulation IV, Rule 67.6.

611.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

611.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rules 23.F.15, or 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: Rule 74.6 does not apply to the stripping of cured coatings.

612 OXIDE LINE

Converts Copper to Copper Oxide

Process Description: Converts copper to copper oxide (the copper oxide portion of the core is black in color).

Other types of equipment used for this source: conveyorized lines.

Figure 612.1
Oxide Line

612.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 118.4 or 118.5.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Comments: Other types of oxide lines are found in the District, for example, Tin Immersion Oxide.

Compliance Determination: Materials used at these sources typically do not contain any volatile organic compounds or emit any toxic air contaminants.

612.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This line would be exempt from permit requirement per Rule 291(1)(4), because it is alkaline and has acidic microetching.

612.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

612.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions. Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

612.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Comments: Assume all the materials used are inorganic and no toxic emissions are expected.

613 LAY UP AREA

Process Description: Inner layers are sorted, awaiting "Book" assembly.

Inner Layers Sorted, Awaiting "Book" Assembly.

Figure 613.1
Lay Up Area

613.1 SUMMARY OF BAAQMD REQUIREMENTS

No district requirements.

613.2 SUMMARY OF SCAQMD REQUIREMENTS

No district requirements.

613.3 SUMMARY OF SDCAPCD REQUIREMENTS

No district requirements.

613.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

613.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

614 INNER LAYERS ASSEMBLED TO CREATE "BOOK"

Inner Layers are Separated by Pre-Preg

Process Description: Inner layers are separated by pre-preg, with the top and bottom consisting of copper foil.

Figure 614.1
Inner Layers Assembled To Create The "Book"

614.1 SUMMARY OF BAAQMD REQUIREMENTS

No district requirements.

614.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This line would be exempt from permit requirement per Rule 291(1)(4), because it is alkaline and has acidic microetching.

614.3 SUMMARY OF SDCAPCD REQUIREMENTS

No district requirements.

614.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: Unknown--May apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020. Toxics--dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

614.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

615 MULTILAYER LAMINATION PRESS

The "Book" is Laminated by Heat and Pressure

Process Description: The "Book" is laminated by heat and pressure.

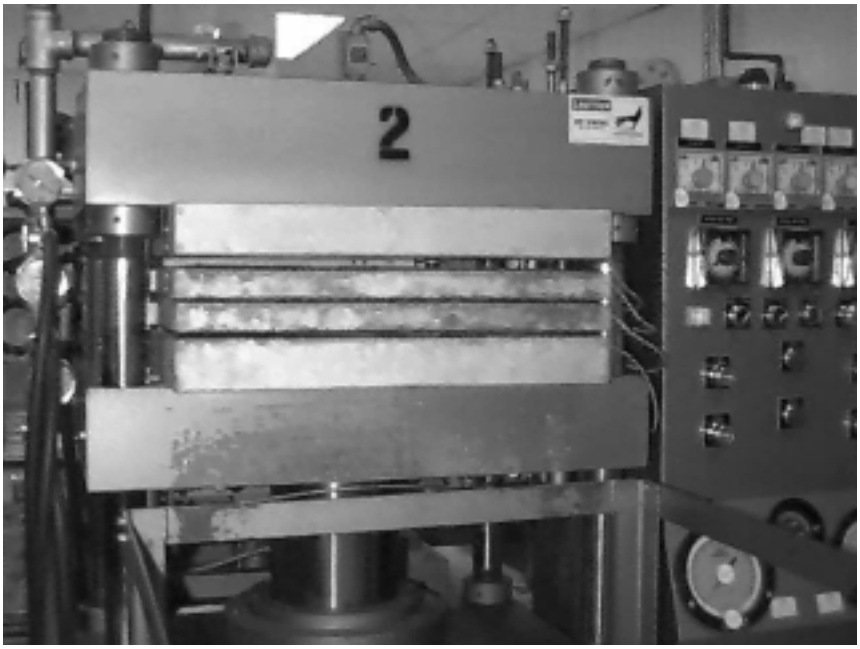


Figure 615.1
Multilayer Lamination Press

615.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Compliance Determination: None. There may be some off-gassing of organic compounds from this process; however, no significant toxic emissions are expected from this source.

615.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Slight odors and maybe some smoke. However, emissions of VOC would be less than 3 lb/day, therefore no district requirements.

615.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Process does not require a Permit to Operate. Permit may be required for press, ie. boilers for heat production.

615.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020. Toxics--dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

615.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.12.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source could be subject to Regulation IV, Rule 74.20, Adhesives and Sealants.

616 CIRCUIT BOARD DRILLING

Process Description: Small holes are drilled in the board.

Small Holes are Drilled in the Board

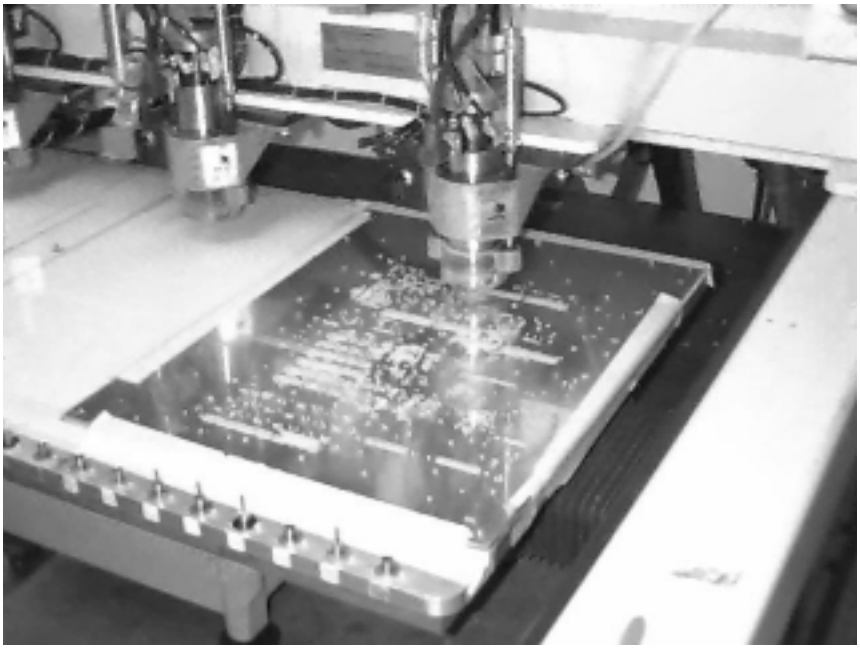


Figure 616.1
Circuit Board Drilling

616.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 125.1.2.

Regulations: This source is subject to Regulation 6, Section 301 because of possible visible emissions from the baghouse exhaust.

Compliance Determination: Check for excessive visible emissions from the baghouse exhaust stack to verify compliance with the standards in Regulation 6.

616.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There can be emissions from cutting/shearing of fiberglass, and some of the equipment in the District are vented to baghouses. Equipment and control equipment (baghouse) are exempt from permit requirement per Rule 219(g)(1).

616.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Permit required, fiberglass machining.

Permit Conditions: Collection & proper disposal of fiberglass dust.

Regulations: Rule 50

616.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Permit Conditions: Permit conditions for processes which may emit particulate matter may include: visible emissions standards, throughput, disposal of collected material.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration.

616.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23, Section B.4.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source could be subject to Regulation IV, Rule 50, Opacity.

617 BAGHOUSE

Drill Dust Collection

Process Description: Drill dust collection.

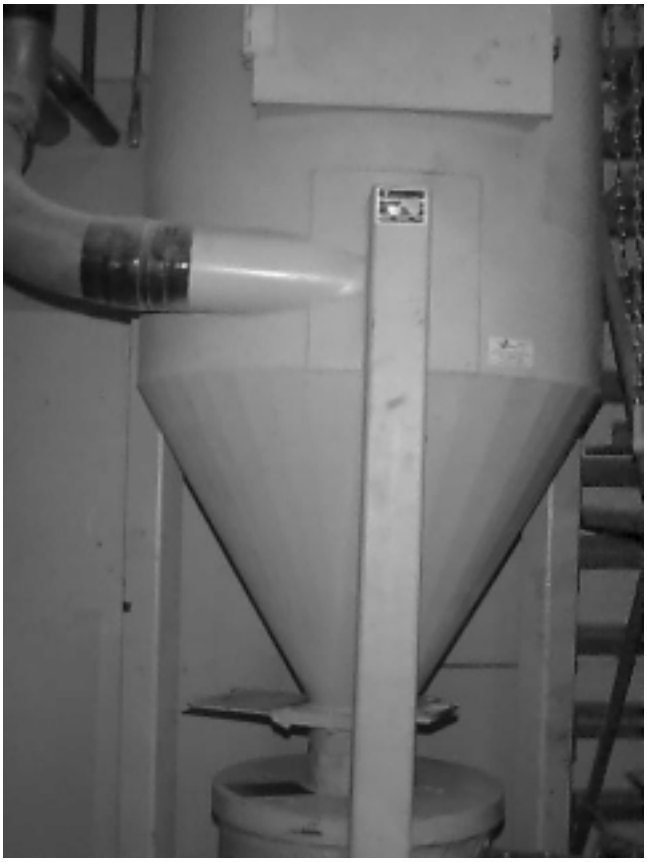


Figure 617.1
Baghouse

617.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This abatement device is typically exempt under Regulation 2, Rule 1, Section 113.2.4.

Regulations: This abatement device which is connected to the drilling and routing sources is subject to Regulation 6 because of possible visible emissions from the baghouse exhaust.

Compliance Determination: Check for excessive visible emission from the baghouse exhaust stack to verify compliance with the standards in Regulation 6.

617.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There can be emissions from cutting/shearing of fiberglass, and some of the equipment in the District are vented to baghouses. Equipment and control equipment (baghouse) are exempt from permit requirement per Rule 219(g)(1).

617.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Permit required, part of Circuit Board Drilling permit requirements.

Regulations: Regulation IV, Rule 50

617.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: Permitted as part of PM producing process.

617.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This abatement device is typically exempt under Regulation II, Rule 23, B.4.

Regulations: This abatement device could be subject to Regulation IV, Rule 50, Opacity.

618 ELECTROLESS COPPER PLATING LINE AND METALIZATION

Panels are Subject to a Variety of Baths and Rinse

Process Description: Panels are subject to a variety of baths and rinses.

Other types of equipment used for this process: Conveyorized Lines

Figure 618.1
Electroless Copper Plating Line and Metalization

618.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: These series of baths are used for drill hole cleaning, electroless copper plating or metallization of the surface and drill holes.

Regulations: VOC containing baths which are a part of this line are subject to Regulation 8, Rule 4. Solutions used at these sources are usually in compliance with the 5 tons VOC limit (8-4-302).

618.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Most of the electroless copper plating processes use solution with formaldehyde. Rule 1401 is applied, so a permit is required because of the preamble to Rule 219.

618.3 SUMMARY OF SDCAPCD REQUIREMENTS

VOC containing tanks which are a part of the process would require a Permit to Operate unless exempt by Regulation II, Rule 11.

618.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

618.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: VOC containing baths which are part of this line are subject to regulation.

Comments: Assume baths / rinses contain low amounts of VOCs. Cleaning activities would be subject to Regulation IV, Rule 74.12, Surface Coating of Metal Parts, if it could be argued that this step is a protective coating.

619 DESMEAR CONDITIONER

Softens the Drill Smear

Process Description: Softens the drill smear.

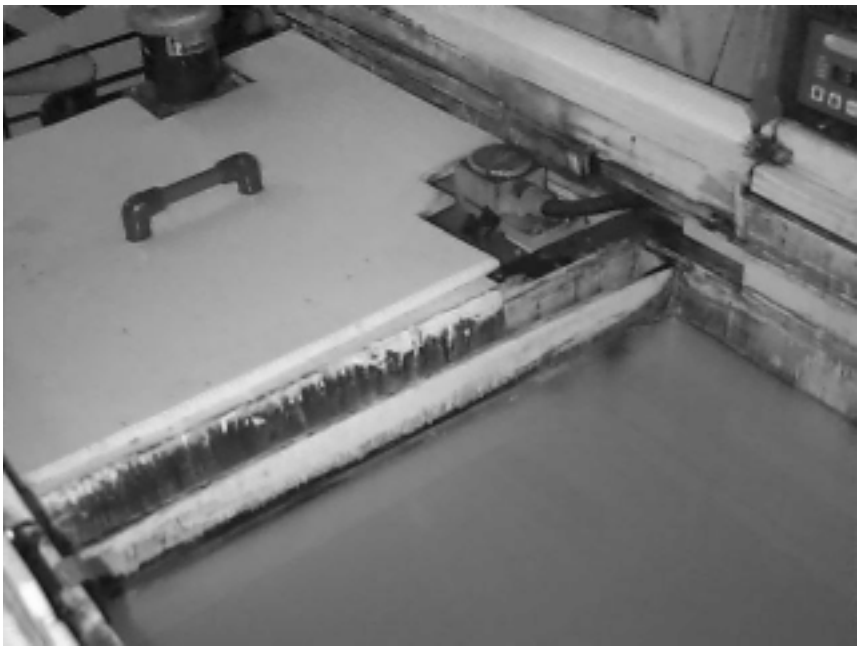


Figure 619.1
Desmear Conditioner

619.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by: Regulation 2, Rule 1, Section 118.4, 118.5 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing no organic compounds and not emitting any significant amounts of toxic air contaminants. No compliance determination is necessary.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118). These exempt sources in the District's inventory, are typically the 5 ton VOC limit.

3. Those containing organic compounds with concentrations 2.5% VOC and emitting <10 lb VOC per day (2-1-103). These exempt sources comply with the 5 ton limit in Regulation 8 Rule 4.

4. Those containing organic compounds with concentrations 2.5% VOC and the source requires a Permit to Operate. Throughput limits should be verified to determine compliance with the permit conditions. The permit condition should reflect compliance with the 5 ton limit in Regulation 8 Rule 4. If the permit condition limits are exceeded the inspector should follow current enforcement policy.
   Records should be kept per Regulation 8 Rule 4 and District permit conditions, if applicable.

619.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Usually an alkaline process, so equipment is exempt from permit requirement per Rule 219 (1)(4).

619.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

619.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

619.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.6, if this step is defined as a solvent cleaning operation.

620 DESMEAR PERMANGANATE TANK

Process Description: Removes the drill smear.

Removes the Drill Smear

Figure 620.1
Desmear Permanganate Tank

620.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 118.5 or 103.

Compliance Determination: The materials used at these sources typically do not contain any volatile organic compounds or emit toxic air contaminants in excess of the trigger levels.

620.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Usually an alkaline process, so equipment is exempt from permit requirement per Rule 219 (1)(4).

620.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

620.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

620.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.I.9. or 23.F.10.d.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to individual permit conditions.

Regulations: This source is subject to Regulation IV, Rule 74.6.

621 DESMEAR PLASMA ETCHING

Process Description: Removes the drill smear.

Removes the Drill Smear

Figure 621.1
Desmear Plasma Etcher

621.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 124.1.4 and 128.19; however, if the Toxic trigger level is met, a Permit to Operate may be required.

Toxics: Refer to Regulation 2, Rule 1, Section 316. toxic trigger levels are found in Appendix E.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Comments: The desmear plasma process is used as an alternative to the desmear conditioner and permanganate processes.

Compliance Determination: The materials used at these sources typically do not contain any volatile organic compounds. The Plasma etchers in the District have been deemed to be functionally equivalent to the plasma etchers in the semiconductor industry which are exempt from permits per 2-1-124.1.4 and 2-1-128.19. Plasma etchers may require a Permit to Operate if any toxic emissions exceed the risk screening trigger level. Contact the District Permit Engineer for evaluation. Records may be required by District permit conditions.

621.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There are some PCB companies that use Plasma Desmear equipment and that will require permits per Rule 219(1)(4) due to by-product emissions of HF, CO, HCL, etc.

621.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

621.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

621.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.I.9. or Rule 23.F.10.d. or Rule 23.F.15.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.6, if defined as a solvent cleaning operation.

622 CATALYST APPLICATION

Process Description: Deposits palladium for electroless copper.

Deposits Palladium for Electroless Copper

Figure 622.1
Catalyst Application

622.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is exempted by Regulation 2, Rule 1, Section 125.1.1

622.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This equipment is included in the permit for the electroless copper plating line.

622.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

622.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: Unknown--may apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

622.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is part of the *electroless copper plating line* and is typically exempt under Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

Comments: Assume process uses dilute aqueous solution, covered as specified in Regulation II, Rule 23.I.9.

623 ELECTROLESS COPPER BATH

Process Description: The drill holes are plated with a thin layer of electroless copper.

Drill Holes are Plated with a Thin Layer of Electroless Copper

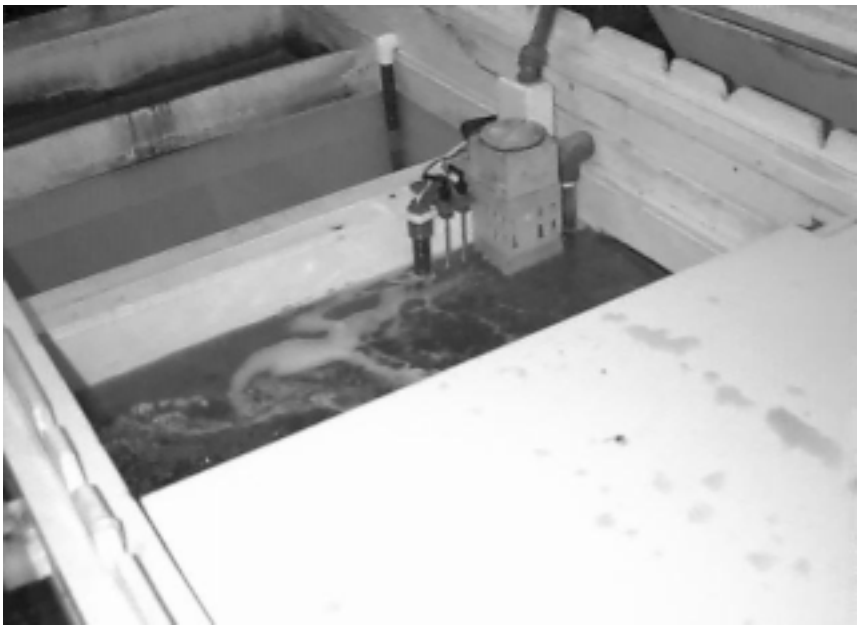


Figure 623.1
Electroless Copper Bath

623.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is part of the electroless copper plating line and it is typically exempt under Regulation 2, Rule 1, Section 125.1.1, unless toxic emissions for formaldehyde, which may be used as a reducing agent, are above the risk screen trigger levels.

Toxics: Refer to Regulation 2, Rule 1, Section 316. Toxic trigger levels are found in the Appendix E.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The emissions from these sources comply with the 5 ton limit in Regulation 8 Rule 4; however, formaldehyde, which is used as a reducing agent in this source, may necessitate a Permit to Operate if the toxic risk screen trigger level is exceeded. If subject to a permit, throughput limits should be verified to determine compliance with permit conditions. Records should be kept per Regulation 8 Rule 4 and District permit conditions, if applicable.

623.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Most of the electroless copper plating processes use solution with formaldehyde. Rule 1401 is applied, so a permit is required because of the preamble to Rule 219.

623.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

623.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

623.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is part of the electroless copper plating line and it is typically exempt under Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to individual permit conditions.
Regulations: This source may be subject to Regulation IV, Rule 51, Nuisance.
Comments: Assume process uses a dilute aqueous solution as specified in Regulation II, Rule 23.I.9.

624 ANTI TARNISH

Process Description: Used to prevent copper oxidation after electroless copper.

Used to Prevent Copper Oxidation After Electroless Copper

Figure 624.1
Anti Tarnish

624.1 SUMMARY OF BAAQMD REQUIREMENTS:

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 119.2 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: This is a coating source. The emissions from these sources comply with the 5 ton limit in Regulation 8, Rule 4. If subject to a permit, throughput limits should be verified to determine compliance with the permit conditions. Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

624.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: These mechanical cleaning and alkaline surface preparation operations are exempt from permit requirement per Rule 219(g) and 219(1)(4).

624.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

624.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020. Toxics--dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

624.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is part of the electroless copper plating line and it is typically exempt under Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 51, Nuisance.

Comments: Assume process uses a dilute aqueous solution as specified in Regulation II, Rule 23.I.9.

625 DRY FILM PHOTO RESIST APPLICATION (OUTER LAYER)

Process Description: Dry film is applied to panel after electroless copper or direct metallization.

Dry Film is Applied to Panel After Electroless Copper or Direct Metallization

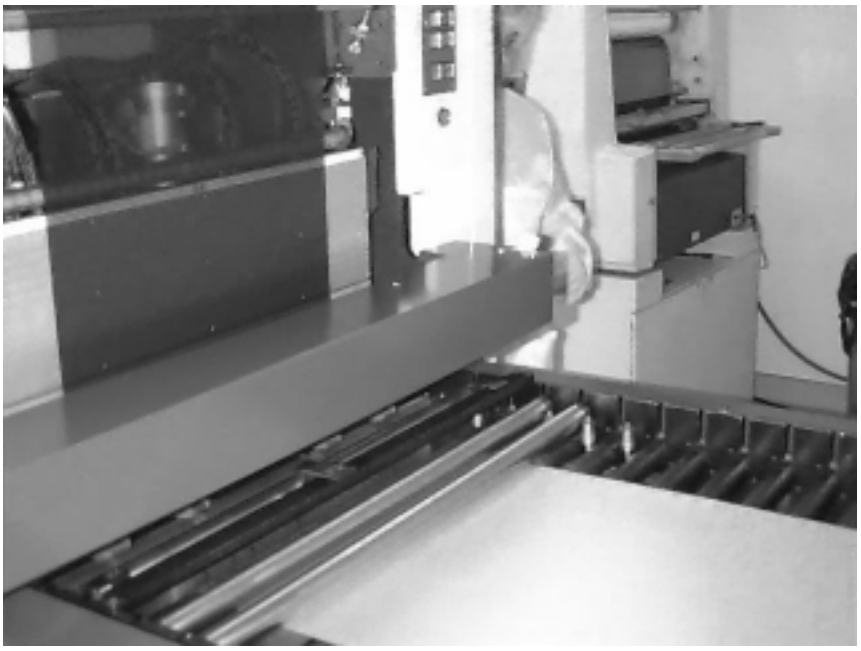


Figure 625.1
Dry Film Photo Resist Application (Outer Layer)

625.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 119.2.2, even though toxic air contaminants may be emitted. See Compliance Determination section below.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: This is a coating source. Currently, all dry film photo resist operations are expected to comply with the 5 ton VOC limit (8-4-302.1). The dry film used at these sources typically emit 50 lb VOC per million square feet (mmft^2) of film laminated; therefore, a source would exceed the 5 ton VOC limit only if it used more than 200 mmft^2 of film. In 1997, no facility in the District approached these amounts. Dry film resists now used in the industry emit toxic air contaminants but not at such quantities necessary to require a risk screen analysis and Permit to Operate. Toxics would be an issue only if a facility uses approximately 126 mmft^2 of film. In 1997, no facility approached these limits. Records are required by Regulation 8, Rule 4.

625.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt from permit requirement per Rule 219(h)(1). Some of the larger units have permits because emissions are greater than 3 lb/day VOC.

625.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

625.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

625.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempt under Regulation II, Rule 23.F.11.b.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.20, Adhesives and Sealants.

626 NEGATIVE IMAGE EXPOSURE

Process Description: The desired image is exposed to UV light.

The Desired Image is Exposed to UV Light

Figure 626.1
Negative Image Exposure

626.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 127.2.

Compliance Determination: None. These sources do not emit any significant amounts of volatile organic compounds or emit toxic air contaminants in excess of the trigger levels.

626.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There are slight VOC emissions from the curing of the coating, but they are exempt from permit requirement per Rule 219(h)(1) and 219(h)(2).

626.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

626.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: If regulated, may be part of process in Dry Film Photo Resist Application (Outer Layer). May apply if the following conditions are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

626.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

627 DEVELOPER

The Developer Removes the Resist from the Desired Image

Process Description: The developer removes the resist from the desired image (unexposed image).

Figure 627.1
Developer

627.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.5 or 103. Developers using heated solutions with a VOC content of less than 2.5% (wt) are exempt. Developers which are not exempt per Section 118.5 are exempt if VOC emissions are less than 10 pounds a day or less than 150 pounds a year.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing no organic compounds. Most inner layer developer solutions in the Bay Area use an aqueous potassium carbonate solution; therefore, after verifying there are no organics, no compliance determination is necessary.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118.5). These exempt sources, in the District's current inventory, are typically 5 tons VOC (8-4-302).

3. Those containing organic compounds with concentrations >2.5% VOC and emitting <10 lb VOC per day (2-1-103). These exempt sources comply with the 5 ton limit in Regulation 8, Rule 4.

4. Those containing organic compounds with concentrations >2.5% VOC and requiring a Permit to Operate. Throughput limits should be verified to determine compliance with the permit conditions. The permit conditions should reflect compliance with the 5 ton limit in Regulation 8, Rule 4. If the permit condition limits are exceeded the inspector should follow current enforcement policy.

NOTE: Developers may be grouped and conditioned as one source, combining the etcher and stripper sources. These sources together are referred to as the D.E.S. line. Developers in the District's current inventory are all using heated solutions. Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

627.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source typically uses alkaline solutions and is therefore exempt from permit requirement per Rule 219(1)(4).

627.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Process tanks using solutions containing VOCs of less than 10% by weight are exempt.

627.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

627.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: If subject to a permit, refer to the individual permit conditions.

628 ELECTROPLATING

Process Description: The image is copper plated.

Other types of equipment used for this process: Automated lines.

The Image is Copper Plated

Figure 628.1
Electroplating

628.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 125.1.1 or 127.3.

Regulations: This source may be subject to Regulation 8 Rule 4 if this source contains organic compounds.

Compliance Determination: Formaldehyde may be found in very small concentrations at this source; however, these sources are expected to comply with the 5 ton VOC limit. Records should be kept per Regulation 8 Rule 4, if applicable.

628.2 SUMMARY OF SCAQMD REQUIREMENTS

The acidic copper plating lines are not exempt from permit requirements per Rule 219(1)(5) and need permits.

628.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: A Permit to Operate would be required for copper plating using formaldehyde, ammonium hydroxide, ammonium chloride, or solutions of nitric, hydrofluoric and/or hydrochloric acids which contain more than 17% acid by weight.

628.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: Source typically exempt-may apply if the following are met: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

628.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23.I.9.

629 TIN AND TIN LEAD PLATING

Tin or Tin Lead Plated to Protect the Copper from the Etching Operation

Process Description: The board is tin or tin lead plated to protect the copper from the etching operation.

Other types of equipment used for this process: Automated lines.

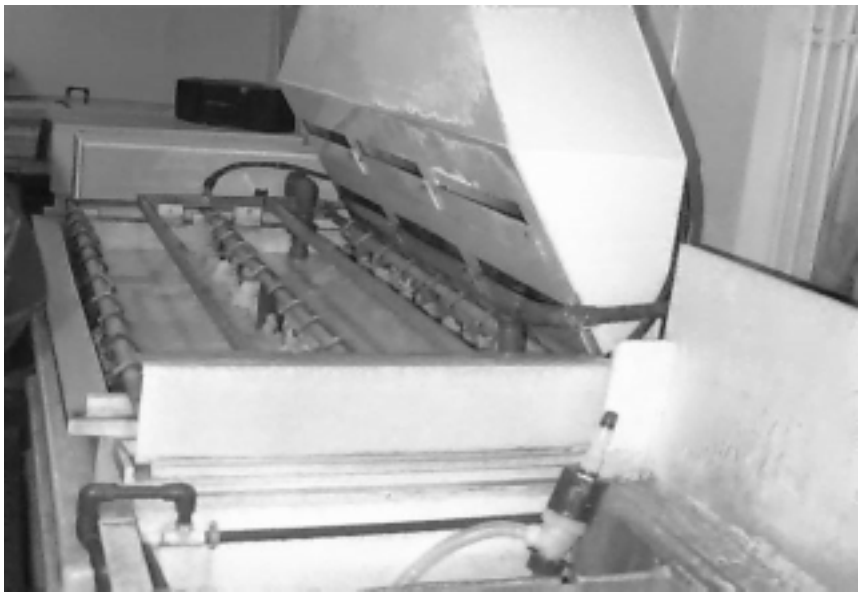


Figure 629.1
Tin and Tin Lead Plating

629.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 125.1.1. Lead emissions from tin-lead plating operations are expected to be well below the lead risk screening trigger level.

Comments: Tin-lead plating is gradually being replaced by tin plating. In some shops the tin-lead plate is left on rather than being stripped off after etching.

NOTE: This process is being phased out by hot air leveling and alternative organic coatings.

629.2 SUMMARY OF SCAQMD REQUIREMENTS

Tin and lead plating would be exempt from permit requirement per Rule 219(1)(5) if solutions do not contain hydrochloric or sulfuric acids. Some of this equipment would be included in the permit for the copper plating line.

629.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Equipment used for plating is exempt if VOC content of solutions does not exceed 10% per Regulation II, Rule 11.

629.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be subject to permits--if so, the following apply: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

629.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

630 PHOTO RESIST STRIPPER

Process Description: The stripper removes the polymerized photo resist image.

Other types of equipment used for this process: Dip tanks and other manufacturers of conveyorized equipment.

The Stripper Removes the Polymerized Photo Resist Image

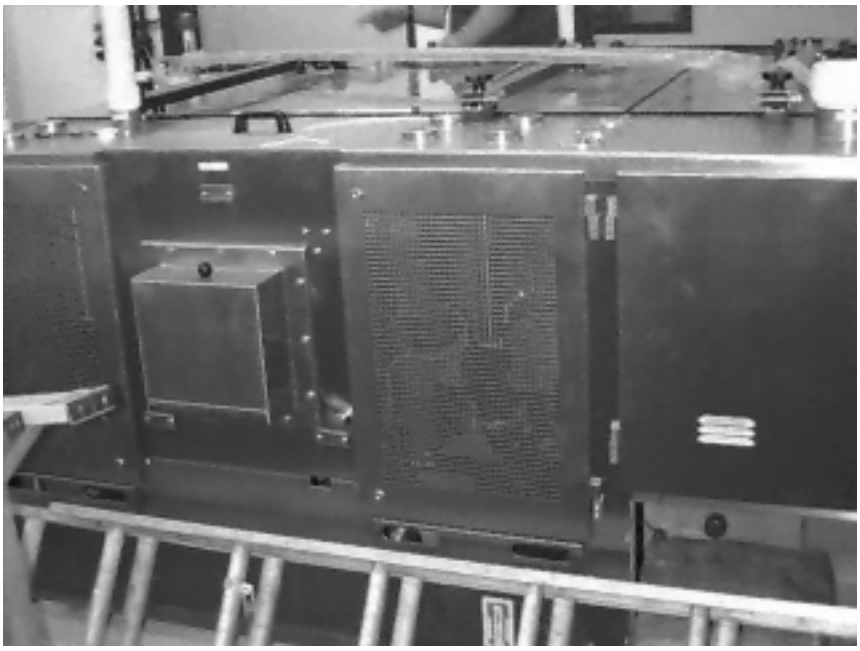


Figure 630.1
Conveyorize Photo Resist Stripper
Conveyorized Stripper

630.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 118.5 or Section 103. Strippers using heated solutions with a VOC content of less than 2.5% (wt) are exempt. Strippers which are not exempt per Section 118.5 are exempt if VOC emissions are less than 10 pounds a day or less than 150 pounds a year.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing organic compounds with concentrations that are >2.5% VOC and the source requires a Permit to Operate. Throughput limits should be verified to determine compliance with permit conditions. The permit conditions should reflect compliance with the 5 ton limit in Regulation 8, Rule 4. If the permit condition limits are exceeded the inspector should follow current enforcement policy.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118). These exempt sources in the District's current inventory are typically 5 ton VOC (8-4-302).

3. Those containing organic compounds with concentrations >2.5% VOC and emitting <10 lb VOC per day (2-1-103). These exempt sources comply with the 5 ton limit in Regulation 8, Rule 4.

NOTE: Strippers may be grouped and conditioned as one source, combining the developer and etcher sources. These sources together are referred to as the D.E.S. line. Strippers in the District's current inventory are all using heated solutions. Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

630.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Probably, since most strippers use VOCs (MEA, Glycol Ether) containing materials. If the VOC concentration is less than 20 gm/liter, then the equipment is exempt from permit requirement. Most are greater than that, therefore require permits per Rule 219-1-15..

630.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Exempt if less than 10% VOC by weight.

630.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

630.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.6, as a cleaning operation of an uncured coating. Stripping of cured coatings is exempt from Rule 74.C.1.e.

631 ETCHER

Removes all Unwanted Copper from Undesired Image.

Process Description: Removes all unwanted copper from undesired image.

Other types of equipment used for this process: Other manufacturers of conveyorized equipment.

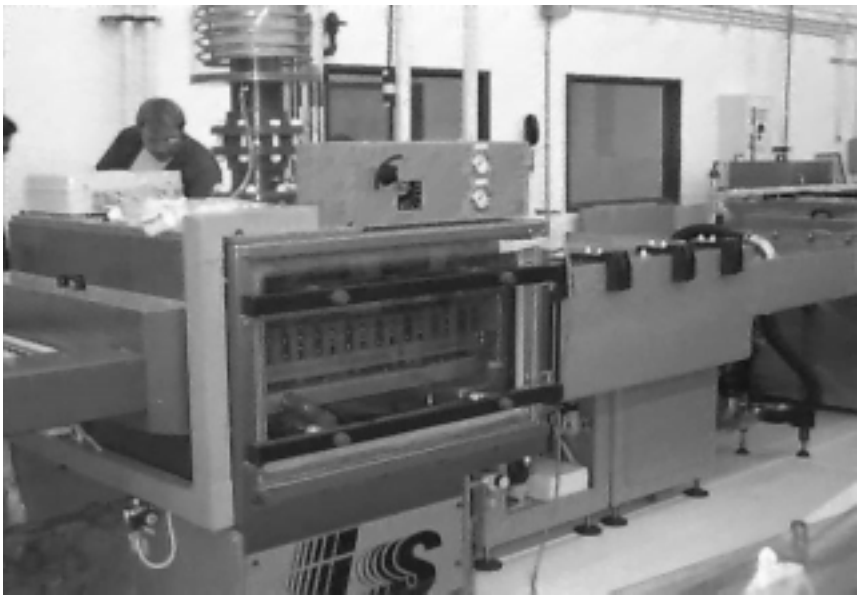


Figure 631.1
Etcher

631.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 127.4 or 103. Etchers using ammonia exceeding the toxic risk screening trigger level may require a Permit to Operate.

Toxics: Refer to Regulation 2, Rule 1, Section 316. Toxic trigger levels are found in Appendix E.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: Sources using ammonia etchants are not subject to Regulation 8, Rule 4. These sources can be odorous and may be subject to Regulation 7.

Compliance Determination: Generally, outer layer etchers use ammonia based etchants. If a Permit to Operate is required, throughput limits should be verified to determine compliance with the permit conditions. Records may be required by District permit conditions.

631.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Circuit board etchers and the control units (scrubbers) using ammonia based etchant require permits. Others are exempt from permit requirement per Rule 219 (1)(4).

631.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Etchers using ammonium hydroxide, ammonium chloride, or solutions of nitric, hydrofluoric and/or hydrochloric acids which contain more than 17% acid concentration by weight require a district permit.

Permit Conditions: Operational parameters to minimize odors and NOx emissions.

Regulations: No specific rule except public nuisance concerns.

631.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

631.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rules 23.F.15, or 23.I.9.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: May be subject to Regulation IV, Rule 51, Nuisance, if odorous.

632 TIN AND TIN LEAD STRIPPING

Process Description: Strips the tin or tin lead from the circuit to expose the copper.

Strips the Tin or Tin Lead from the Circuit to Expose the Copper

Other types of equipment used for this process: Dip tanks and other manufacturers of conveyorized equipment.

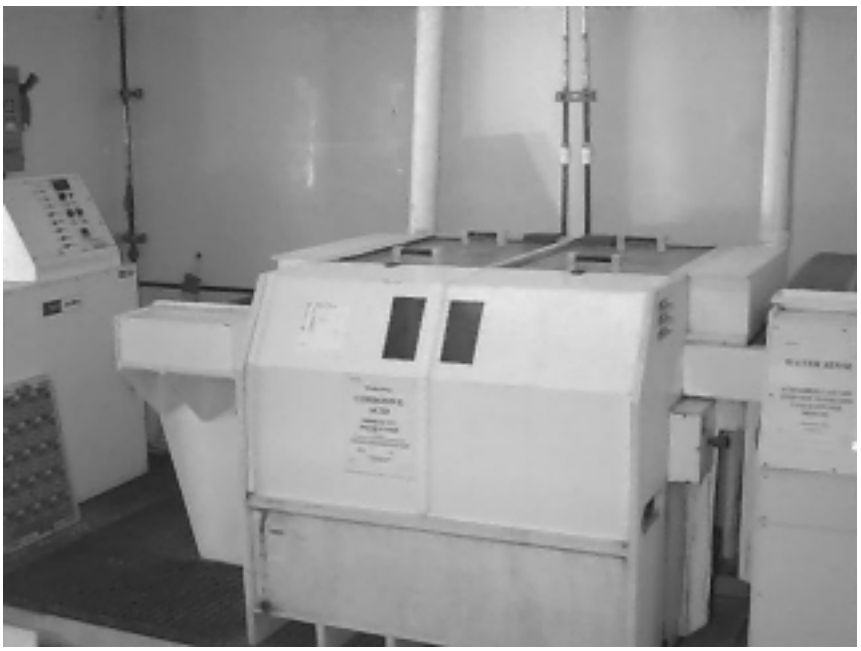


Figure 632.1
Tin and Tin Lead Stripping

632.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: Tin or tin lead chemical stripping baths are exempt from permit requirements per Regulation 2, Rule 1, Section 118.4 or 118.5. Electrolytic tin stripping is exempt from permit requirements per Regulation 2, Rule 1, Section 127.3. Electrolytic tin lead stripping is usually exempt from permit requirements per Regulation 2, Rule 1, Section 103.

Comments: Tin or tin lead chemical stripping baths do not contain organic compounds or emit toxic air contaminants. Electrolytic tin lead stripping is not expected to emit significant quantities of lead.

632.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Tin and tin lead stripping is usually exempt from permit requirement per Rule 219(1)(4).

632.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

632.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

632.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation II, Rule 23.I.9.

Toxics: Refer to Appendix C.

633 LIQUID PHOTO IMAGEABLE (LPI) SOLDER MASK

Coats the Circuit Board with LPI Solder Mask

Process Description: Coats the entire circuit board with LPI solder mask.

Other Types of Processes: Dry film solder mask and manual screening.

Figure 633.1
Liquid Photo Imageable (LPI) Solder Mask

633.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.2 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: This source is a coating operation subject to a 5 ton VOC limit by Regulation 8, Rule 4. However, coatings used that are less than 3.5 lb/gal (420 g/l) VOC as applied will not be counted towards the 5 ton VOC limit. Another compliance option is to use an abatement device capable of reducing VOC emissions by 85% on a mass basis or 90% by weight if incinerated. Throughput limits should be verified to determine compliance with permit conditions.

NOTE: Solvent clean-up operations are generally done by solvent wipe cleaning. The solvent usage may be included in a facility-wide wipe cleaning Permit to Operate. Wipe cleaning operations are subject to quarterly record keeping requirements in Regulation 8, Rule 16 and the closed container requirements in Regulation 8, Rule 1. Permit conditions, however, may require monthly record keeping. Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

633.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Normally permit not required per Rule 219(h)(1), as the VOC emissions are less than 3 lb/day.

633.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Source would require a Permit to Operate if solder mask has VOC content of greater than 20g/l.

633.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for the list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for processes which may emit particulate matter may include: visible emissions standards, throughput, disposal of collected

material. Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration, Rule 4661--Organic Solvents.

633.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempt by Regulation II, Rule 23.F.I.7.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source is specifically exempt from Regulation IV, Rules 74.19 and 74.19.1.

634 TACK DRY OVEN

Process Description: Dries the LPI solder mask to a tacky state

Dries the LPI Solder Mask to a Tacky State

Other types of equipment used for this process: standard cabinet ovens

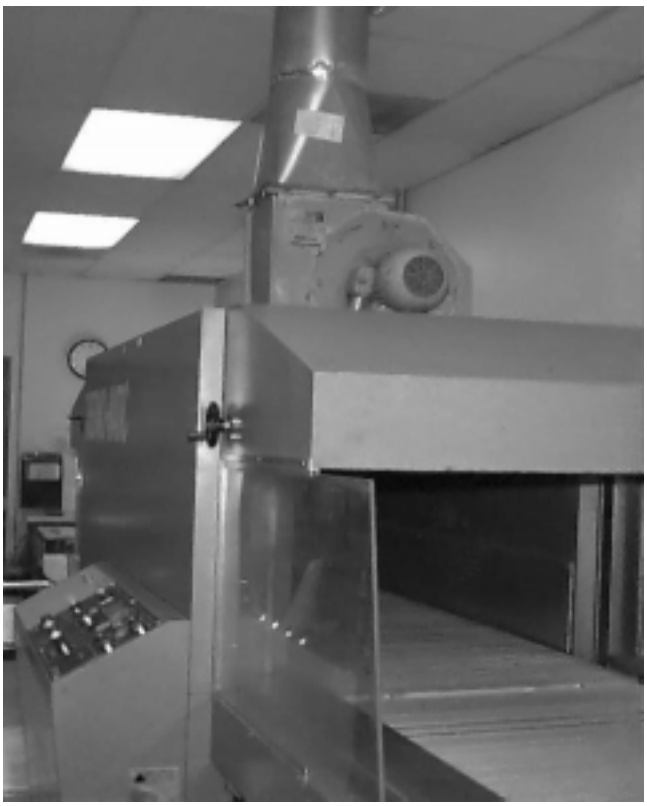


Figure 634.1
Tack Dry Oven

634.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.4 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions in the source's Permit to Operate.

Comments: Tack dry ovens associated with LPI solder mask coating operations may be grouped under a single source number, in accordance with District policy.

634.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: May require permit per Rule 219(h)(1), if the VOC emissions are greater than 3 lb/day per equipment.

634.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Oven would typically be included as part of LPI application process and included on the Permit to Operate.

634.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Typically permitted as part of process in Liquid Photo Imageable Solder mask. However, may be permitted separately. If so, it is subject to the following:

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration.

634.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.C.1.
Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 50, Opacity, and Rule 51, Nuisance.

635 IMAGE EXPOSURE

Process Description: The area outside the desired image is exposed to UV light.

The Area Outside the Desired Image is Exposed to UV Light

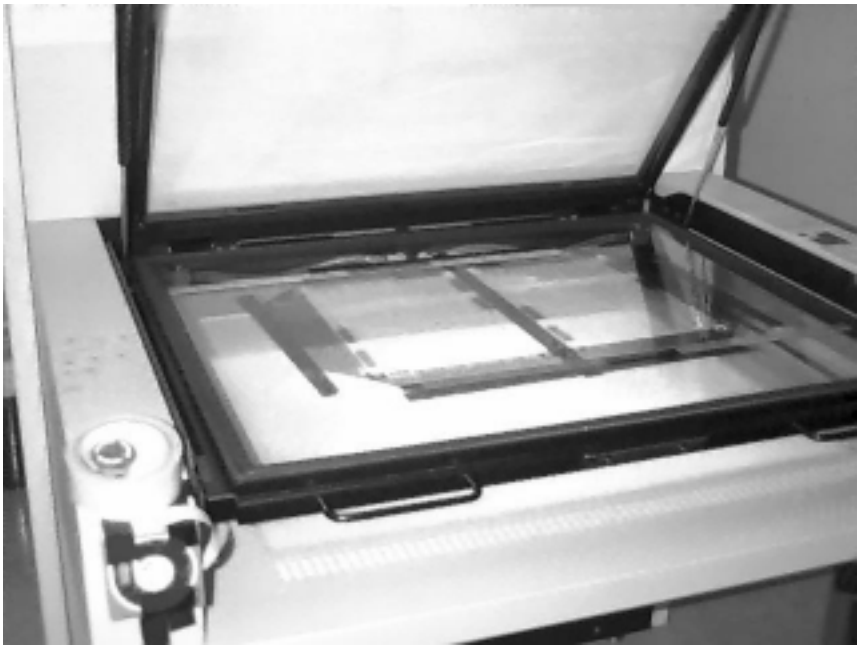


Figure 635.1
Image Exposure

635.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 127.2.

Compliance Determination: None. These sources do not emit any significant amounts of volatile organic compounds or emit toxic air contaminants in excess of the trigger levels.

635.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Slight VOC emissions from the curing of the coating, but they are exempt from permit requirement per Rule 219(h)(1) and 219(h)(2).

635.3 SUMMARY OF SDCAPCD REQUIREMENTS

No district requirements.

635.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be subject to permits dependent upon uncontrolled emissions. In general, if a process emits >2 lbs/day of a pollutant, it is required to be permitted. If <2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions.

635.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

636 SOLDER MASK DEVELOPER

Develops Off the Unexposed Solder Mask

Process Description: Develops off the unexposed solder mask.

Other types of equipment used for this process: Several manufacturers of developer units.

Figure 636.1
Solder Mask Developer

636.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: These sources are typically exempt per Regulation 2, Rule 1, Section 118.4, 118.5, or 103.

Compliance Determination: In general, solder mask developer solutions contain no organic compounds. Most developer solutions use an aqueous potassium carbonate solution; therefore, no compliance determination is necessary for these types of sources.

636.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source typically uses alkaline solutions and is therefore exempt from permit requirement per Rule 219(1)(4).

636.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

636.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Typically permitted as part of process in Liquid Photo Imageable Solder mask. However, may be permitted separately. If so, it is subject to the following:

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

636.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: Regulation IV, Rule 74.6 could apply to the removal of uncured

coatings, but the rule does not apply to cured coatings.

637 SOLDER MASK AND FINAL CURE OVEN

Process Description: Solder mask oven: Solder mask cure from the manual screening operation. Final cure oven: Cures the solder mask completely from the L.P.I. operation.

Solder Mask Cure from the Manual Screening Operation

Cures the Solder Mask Completely from the L.P.I. Operation

Figure 637.1
Solder Mask and Final Cure

637.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: Solder mask oven: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.4 or 103.

Final cure oven: This source may be exempted by Regulation 2, Rule 1, Section 116.10.

Permit Conditions: If subject to a permit, refer to individual conditions in the source's Permit to Operate.

Comments: A solder mask oven associated with a solder mask coating operation may be grouped under a single source number, in accordance with District policy.

637.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: May require permit per Rule 219(h)(1), if the VOC emissions are greater than 3 lb/day per equipment.

637.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source would be included in the solder mask application Permit to Operate.

637.4 SUMMARY OF SJVUAPCD REQUIREMENTS

May be permitted as part of solder mask application process or separately.

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration, Rule 4661--Organic Solvents.

637.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.C.1.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 50, Opacity, and Rule 51, Nuisance.

638 SOLDER MASK STRIPPER

Process Description: Removes the solder mask to correct an error and prepares the panel for reprocessing.

Removes the Solder Mask to Correct an Error and Prepares the Panel for Reprocessing

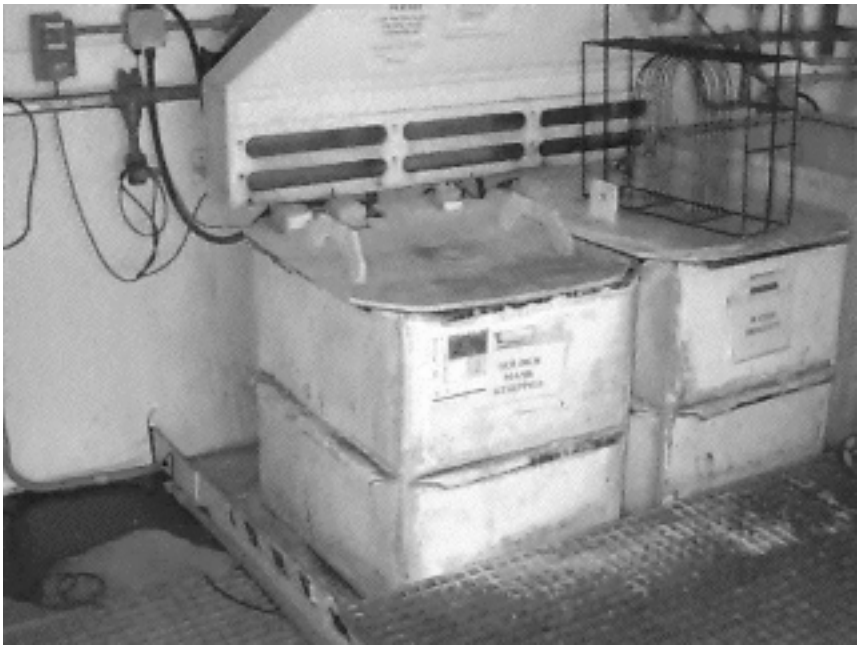


Figure 638.1
Solder Mask Stripper

638.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 118.4, 118.5 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source may be subject to Regulation 8, Rule 4.

Compliance Determination: The organic content of the solution will determine the scope of the inspection. The following types of solutions can be found at these sources:

1. Those containing organic compounds with concentrations that are 2.5% VOC (WT) and the source requires a Permit to Operate: Throughput limits should be verified to determine compliance with permit conditions. The permit conditions should reflect compliance with the 5 ton limit in Regulation 8, Rule 4. If the permit condition limits are exceeded the inspector should follow current enforcement policy.

2. Those containing organic compounds with concentrations <2.5% VOC (2-1-118): These exempt sources in the District's current inventory are typically £5 ton VOC (8-4-302).

3. Those containing organic compounds with concentrations 2.5% VOC and emitting <10 lb VOC per day (2-1-103) are exempt from a Permit to Operate and comply with the 5 ton limit in Regulation 8, Rule 4.

Records should be kept per Regulation 8, Rule 4 and District permit conditions, if applicable.

638.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Most solder mask stripper equipment is exempt from permit requirement per Rule 219(1)(10).

638.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

Regulations: District Rule 67.6

638.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

638.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.6, as a cleaning operation of an uncured coating. Stripping of cured coatings is exempt from Rule 74.6.C.1.e.

639 STENCIL CLEANING

Process Description: Preparation for cleaning of stencils.

Other types of equipment used for this process: Automatic cleaners.

Preparation for Cleaning of Stencils

Figure 639.1
Stencil Cleaning

639.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.4 or 118.7.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: Conduct a Regulation 8, Rule 4 compliance inspection and verify permit condition compliance, if applicable. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

639.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Most stencil cleaning equipment is exempt from permit requirements per Rule 219(1)(10).

639.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: A Permit to Operate would be required if cleaning solution contains VOCs in excess of 10% by weight.

639.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts.

639.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.13.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source is exempt from Regulations IV, Rule 74.6.C.1.f and Rule 74.19.C.5 and 74.19.1.C.4.

640 SILK-SCREENING CLEANING BOOTH

Process Description: Silk-screens are cleaned with a solvent and washed.

Silk-Screens are Cleaned with a Solvent and Washed

Figure 640.1
Silk-Screening Removal/Cleaning Booth

640.1 SUMMARY OF BAAQMD REQUIREMENTS:

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.4, or 118.9.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: The source is subject to Regulation 8, Rule 4.

Compliance Determination: Conduct a Regulation 8, Rule 4 compliance inspection and verify permit condition compliance, if applicable. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

640.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Permit not required, as hand wipe or alkaline wash gun are used in the booth.

640.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: If the cleaning tanks used are greater than one square foot and/or contain VOCs in excess of 10% by weight, then a Permit to Operate is required.

Regulations: Rule 67.6

640.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts.

640.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.15. or Rule 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 74.6.

Comments: This source is specifically exempt from Regulation IV, Rules 74.19. and 74.19.1.

641 PRECLEAN AND FLUX APPLICATION

Process Description: The board is micro-etched, rinsed and flux is applied.

The Board is Micro-Etched, Rinsed and Flux is Applied

Figure 641.1
Preclean and Flux Application

641.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 118.4, 118.5 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Comments: This may be grouped as one source with the Hot Air Leveler.

Compliance Determination: Verify permit condition compliance, if applicable. The permit condition should reflect compliance with the 5 ton VOC limit in Regulation 8, Rule 4. Sources not requiring a Permit to Operate should comply with the 5 ton limit. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable

641.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Equipment is included in the permit for the hot air leveling line.

641.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: If micro-etch solution >10% VOC by weight, a District permit is required.

Regulations: Rule 67.3

641.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be subject to permits dependent upon uncontrolled emissions. In general, if a process emits >2 lbs/day of a pollutant, it is required to be permitted. If <2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions.

641.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.I.7.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source is subject to Regulation IV, Rule 74.6.

642 HOT AIR LEVELING

Process Description: Coat the panel with solder.

Coat the Panel with Solder

Figure 642.1
Hot Air Leveling Equipment

642.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 125.1.3 unless hydrogen chloride or lead emissions exceed toxic trigger levels.

Toxics: Refer to Regulation 2, Rule 1, Section 316. Toxic trigger levels are found in Appendix E.

Comments: Hot Air Leveling has replaced tin lead plating and solder reflow as the primary finish; however, organic coatings are becoming more popular (see the following exhibit). In general, if the fluxer is required to have a permit, the HAL will be grouped as part of that source.

Compliance Determination: Verify that Permit conditions are followed, if applicable.

642.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Hot air leveling equipment requires a permit.

642.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Permit required for operations emitting (on average) 10 lbs. or more of any material containing VOCs, per operating day.

Regulations: Rule 66

642.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

642.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation II, Rule 23.I.7.

Toxics: Refer to Appendix C.

Comments: Assume flux emissions from Preclean and Flux Application have low VOC content.

643 ALTERNATE ORGANIC COATING

Process Description: Protective coating of pads, tips, and holes.

Other types of equipment used for this process: Conveyorized equipment.

Protective Coating of Pads, Tips, and Holes

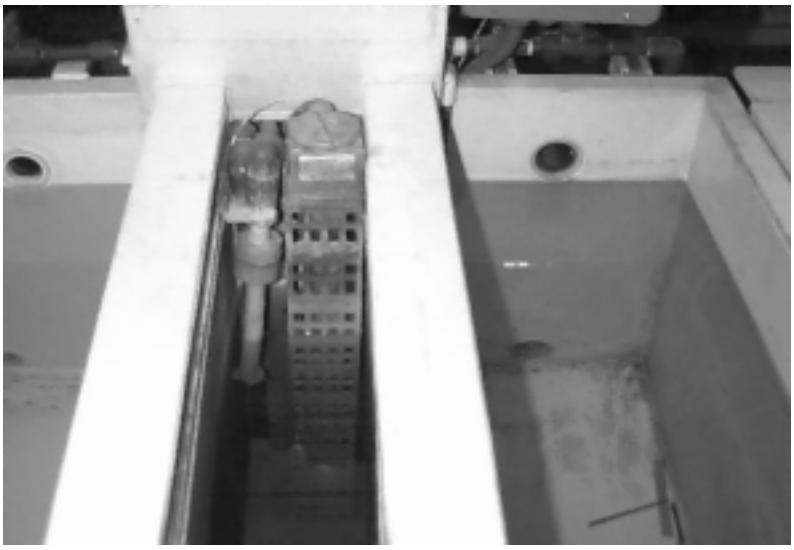


Figure 643.1
Alternate Organic Coating

643.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by: Regulation 2, Rule 1, Sections 119.2 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Comments: This organic coating is used in place of hot air leveling and tin lead plating and solder reflow processes.

Compliance Determination: This is a coating source subject to a 5 ton VOC limit by Regulation 8, Rule 4. However, coatings used that are less than 3.5 lb/gal (420 g/l) VOC as applied will not be counted towards the 5 ton VOC limit. Another compliance option is to use an abatement device capable of reducing VOC emissions by 85% on a mass basis or 90% by weight if incinerated. Throughput limits should be verified to determine compliance with permit conditions. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

643.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This type of equipment would probably be exempt from permit requirement per Rule 219(1)(10) and Rule 219(1)(16).

643.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: If coating is >20g/l and usage exceeds 20 gallons per year, a Permit to Operate is required.

Regulations: Depends on final destination of component. If it goes on an airplane, it is subject to the aerospace rule (District Rule 67.9).

643.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.
Toxics: Dependent upon the solution in use and the associated emissions. See

Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

643.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

644 FLUX IMMERSION TRAY

Process Description: Panels are immersed in a bath of flux to oxidize the solder plate surface in preparation for reflow.

Panels are Immersed in a Bath of Flux to Oxidize the Solder Plate Surface in Preparation for Reflow

Figure 644.1
Flux Immersion Tray

644.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation 2, Rule 1, Section 103.

Regulations: This source is subject to Regulation 8, Rule 4.

Comment: Process flow is Tin Lead Plating, Flux Immersion, then Solder Reflow.

Compliance Determination: These sources typically comply with the 5 ton VOC limit in Regulation 8, Rule 4. Records should be kept per Regulation 8, Rule 4.

644.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This equipment is included in the permit for the solder reflow process.

644.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Solutions containing VOCs in excess of 10% by weight would require a Permit to Operate.

Regulations: Rule 67.6.

644.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

644.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.11.b.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 26, New Source Review regarding BACT.

645 SOLDER REFLOW

Process Description: Plated tin lead is reflowed.

Plated Tin Lead is Reflowed.

Figure 645.1
Solder Reflow

645.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempt by: Regulation 2, Rule 1, Section 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.
Regulations: This source is subject to Regulation 8, Rule 4, and Regulation 6, Section 301 because of possible visible emissions from the stack.

Compliance Determination: These sources typically comply with the 5 ton VOC limit in Regulation 8, Rule 4. In addition the exhaust stack should be checked for compliance with the visible emission standard in Regulation 6. Verify permit condition compliance, if applicable. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

645.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Rule 219(1)(10).

645.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Exempt if emissions (on average) are less than 10 lbs. per day for materials containing VOCs.

Regulations: District Rule 66.

645.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts.

645.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation II, Rule 23.I.7.

Toxics: Refer to Appendix C.
Comments: Assume flux emissions from Preclean and Flux Application has low VOC content.

646 LEGEND APPLICATION

Process Description: Legend inks applied to a printed circuit board through a silk-screen.

Legend Inks Applied to a Printed Circuit Board Through a Silk-Screen

Figure 646.1
Legend Application

646.1 SUMMARY OF BAAQMD REQUIREMENTS:

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.2 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4 and Regulation 8, Rule 16 (wipe cleaning).

Compliance Determination: This source is a coating operation subject to a 5 ton VOC limit by Regulation 8, Rule 4. However, coatings used that are less than 3.5 lb/gal (420 g/l) VOC as applied will not be counted towards the 5 ton VOC limit. Another compliance option is to use an abatement device capable of reducing VOC emissions by 85% on a mass basis or 90% by weight if incinerated. Wipe cleaning

rags shall be disposed of in a closed container per Regulation 8, Rule 1. Throughput limits should be verified to determine compliance with the permit conditions.

NOTE: Solvent clean-up operations are generally done by solvent wipe cleaning. The solvent usage may be included in a facility-wide wipe cleaning Permit to Operate. Wipe cleaning operations are subject to quarterly record keeping requirements in Regulation 8, Rule 16 and the closed container requirements in Regulation 8, Rule 1. Permit conditions, however, may require monthly record keeping. Records should be kept per Regulation 8, Rule 4, Regulation 8, Rule 16 and permit conditions, if applicable.

646.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Normally the legend application has emissions of less than 3 lb/day and is exempt from permit requirement per Rule 219(h)(1).

646.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Yes, if average daily emissions are greater than 15 lbs. per day.

Regulations: District Rule 66.

646.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts.

646.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.13.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Comments: This source is specifically exempt from Regulation IV, Rule 74.19.1, Screen Printing Operations.

647 LEGEND INK CURE OVEN

Process Description: Cures the solder mask completely.

Cures the Solder Mask Completely

Figure 647.1
Legend Ink Cure Oven

647.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.4 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Comments: The legend ink cure oven may be grouped with the legend ink coating operation under a single source number, in accordance with District policy.

647.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: This process may require a permit per Rule 219 (h)(1), if the VOC emissions are greater than 3 lb/day per equipment.

647.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: If process requires a permit, then the oven would be covered by the permit. If not, the oven would be exempt.

647.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: May be permitted as part of *Legend Application* process. In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for a list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4607--Graphic Arts.

647.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.C.1.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source may be subject to Regulation IV, Rule 50, Opacity, and Rule 51, Nuisance.

648 CIRCUIT BOARD PANEL ROUTING

Individual Printed Circuit Boards are Routed from a Panel

Process Description: Individual printed circuit boards are routed from a panel.

Other types of equipment used for this process: Punches

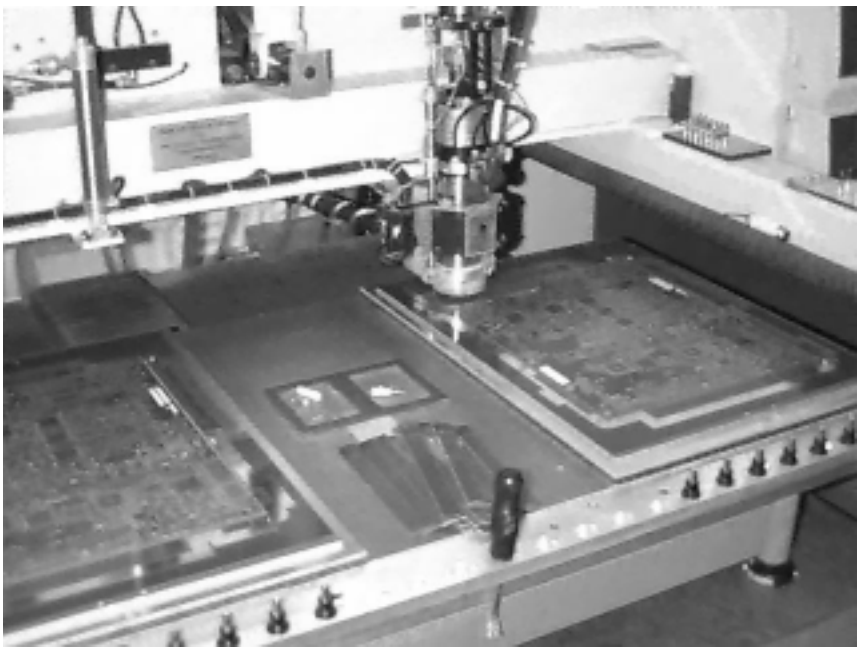


Figure 648.1
Circuit Board Panel Routing

648.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source is typically exempt under Regulation 2, Rule 1, Section 125.1.2.

Regulations: This source is subject to Regulation 6, Rule 301 because of possible visible emissions from the baghouse exhaust (see baghouse).

Compliance Determination: Check for excessive visible emissions from the baghouse exhaust stack to verify compliance with the standards in Regulation 6.

648.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: There can be emissions from cutting/milling of fiberglass, and some of the equipment in the District is vented to baghouses. Equipment and control equipment (baghouse) are exempt from permit requirements per Rule 219(g)(1).

648.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Requires district permit, fiberglass machining.

Permit Conditions: Collection & proper disposal of fiberglass dust.

Regulations: District Rule 50.

648.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Permit Conditions: Permit conditions for processes which may emit particulate matter may include: visible emissions standards, throughput, disposal of collected material. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration.

648.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source may be typically exempt under Regulation II, Rule 23.B.4.

Toxics: Refer to Appendix C.

Regulations: This source is subject to Regulation IV, Rule 50, Opacity and Rule 51, Nuisance because of possible visible emissions from the baghouse exhaust.

649 HAND ASSEMBLY

Process Description: Components are assembled and soldered onto printed circuit boards. The process steps include flux application, hand soldering of components onto boards, and solvent cleaning.

Components are Assembled and Soldered onto Printed Circuit Boards

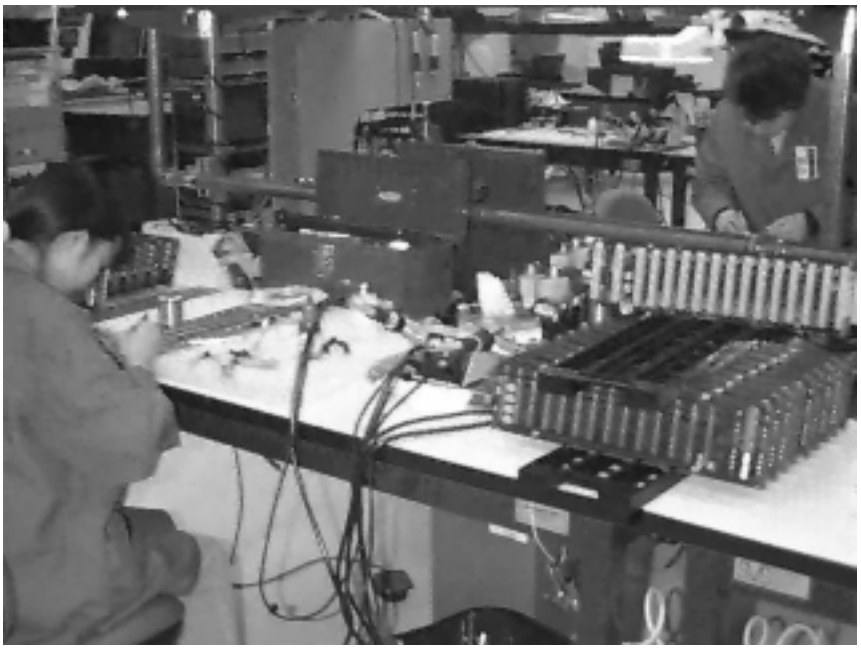


Figure 649.1
Hand Assembly

649.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.4,118.6,118.9, 125.1.3 or 103. If this source is subject to Regulation 8, Rule 16, the exemption under Regulation 2, Rule 1, Section 103 will not apply.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4, Regulation 8, Rule 16, (wipe cleaning) and Regulation 8, Rule 1 (closed containers).

Comments: Regulation 8, Rule 16 and Regulation 8, Rule 1 apply to wipe cleaning operations. Regulation 8, Rule 4 applies to the fluxing, soldering and coating operations.

Compliance Determination: Verify compliance with closed container requirements. Verify permit condition compliance, if applicable. Records should be kept per Regulation 8, Rule 4, and Regulation 8, Rule 16, as applicable. In addition, records may be required by Permit condition.

649.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Hand soldering process is exempt from permit requirement per Rule 219(e)(6).

649.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

649.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for the list of regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4101--Visible Emissions, Rule 4201--Particulate Matter Concentration, Rule 4661--Organic Solvents.

649.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source is subject to Regulation IV, Rule 74.6.

650 SOLDER PASTE APPLICATION

Solder Paste is Applied to Pad Locations on Printed Circuit Board Through a Stencil

Process Description: Solder paste is applied to pad locations on printed circuit board through a stencil.

Other types of equipment used for this process: Various manual and automatic types.

Figure 650.1
Solder Paste Application

650.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 119.2 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: This coating source complies with Regulation 8, Rule 4, Section 302.3 because solder pastes contain 3.5 lb/gal. (420 g/L) VOC. Verify permit condition compliance, if applicable.

NOTE: Solvent clean-up operations are generally done by solvent wipe cleaning. The solvent usage may be included in a facility-wide wipe cleaning Permit to Operate. Wipe cleaning operations are subject to quarterly record keeping requirements in Regulation 8, Rule 16 and the closed container requirements in Regulation 8, Rule 1. Permit conditions, however, may require monthly record keeping. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

650.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Negligible VOC emissions from this process, so no permit required.

650.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Solder screen process is exempt Regulation II, Rule 11.

650.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for the list of regulated HAPs and trigger levels.

650.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rule 23.F.I.7.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: This source is specifically exempt from Regulation IV, Rules 74.19 and 74.19.1.

651 SURFACE MOUNT

Components are Placed onto Printed Circuit Board Pads after Solder Paste

Process Description: Components are placed onto printed circuit board pads after solder paste .

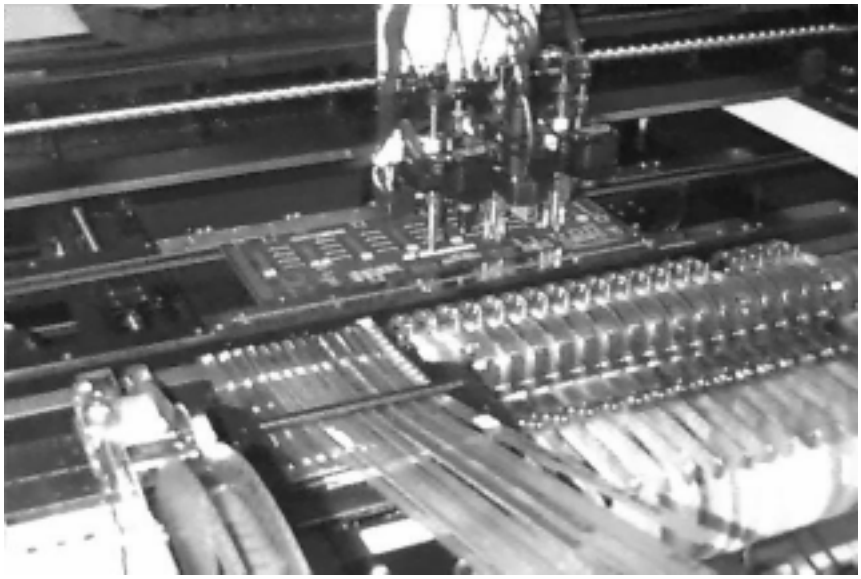


Figure 651.1
Surface Mount

651.1 SUMMARY OF BAAQMD REQUIREMENTS

No district requirements.

651.2 SUMMARY OF SCAQMD REQUIREMENTS

No district requirements.

651.3 SUMMARY OF SDCAPCD REQUIREMENTS

No district requirements.

651.4 SUMMARY OF SJVUAPCD REQUIREMENTS

No district requirements.

651.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

652 INSPECTION

Process Description: During the assembly process the printed circuit board is inspected.

During the Assembly Process the Printed Circuit Board is Inspected

Figure 652.1
Inspection

Comments: This picture was provided to explain the process flow; no emissions occur from this source.

652.1 SUMMARY OF BAAQMD REQUIREMENTS

No district requirements.

652.2 SUMMARY OF SCAQMD REQUIREMENTS

No district requirements.

652.3 SUMMARY OF SDCAPCD REQUIREMENTS

No district requirements.

652.4 SUMMARY OF SJVUAPCD REQUIREMENTS

No district requirements.

652.5 SUMMARY OF VCAPCD REQUIREMENTS

No district requirements.

653 SOLDER PASTE REFLOW

Process Description: The surface mount components are joined to the printed circuit board inside the reflow oven.

The Surface Mount Components are Joined to the Printed Circuit Board Inside the Reflow Oven

Figure 653.1
Reflow Oven

653.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Section 119.4.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Comments: The solder paste reflow oven and the solder paste application equipment may be grouped under a single source number, in accordance with District policy.

653.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Permit not required per Rule 219(e)(6), as usage of VOC containing material is generally less than 1 qt/day.

653.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Solder paste reflow ovens are exempt per Regulation II, Rule 11.

653.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for the list of regulated HAPs and trigger levels.

653.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation II, Rule 23.I.7.
Toxics: Refer to Appendix C.

Comments: Assume flux emissions from Preclean and Flux Application has low VOC content.

654 WAVE SOLDER

Through Hole Components are Soldered to the Printed Circuit Board by a Wave Soldering Machine.

Process Description: Through hole components are soldered to the printed circuit board by a wave soldering machine.

Other types of equipment used for this process: manual soldering

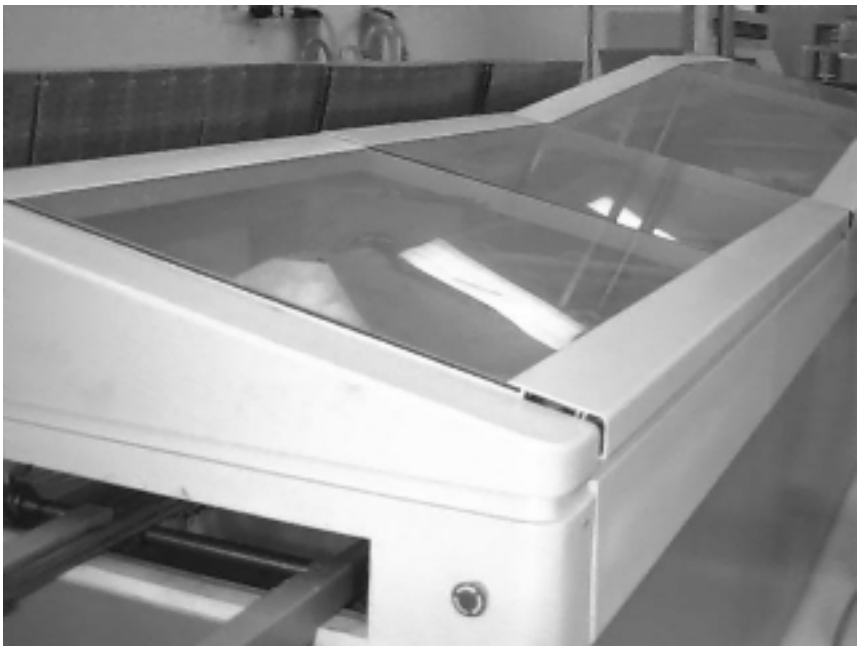


Figure 654.1
Wave Soldering Machine

654.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.4, 118.5, 125.1.3 or 103.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 4.

Compliance Determination: Verify permit condition compliance, if applicable. Records should be kept per Regulation 8, Rule 4 and permit conditions, if applicable.

654.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Permit is required if the flux usage exceeds 1 qt/day per Rule 219(e)(6).

654.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: Yes, if more than an average of 10 lbs of any material containing VOCs are used per operating day.

Regulations: Rule 50, Rule 66.

654.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for the list of regulated HAPs and trigger levels.

654.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source is exempt under Regulation II, Rule 23.I.7.

Toxics: Refer to Appendix C.

Comments: Assume flux emissions from Preclean and Flux Application has low VOC content.

655 CLEANING

During Various Process Steps the Printed Circuit Boards are Cleaned

Process Description: During various process steps the printed circuit boards are cleaned.

Other types of equipment used for this process: cold cleaners and vapor degreasers

Figure 655.1
Tolltronics DI Washer

655.1 SUMMARY OF BAAQMD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation 2, Rule 1, Sections 118.4 through 118.7.

Toxics: Refer to Regulation 2, Rule 1, Section 316. Toxic trigger levels are found in Appendix E.

Permit Conditions: If subject to a permit, refer to individual conditions listed in the source's Permit to Operate.

Regulations: This source is subject to Regulation 8, Rule 16 if the equipment uses a solution containing < 1 % VOC(wt).

Compliance Determination: Conduct a Regulation 8, Rule 16 compliance determination and verify compliance with permit conditions, if applicable.

655.2 SUMMARY OF SCAQMD REQUIREMENTS

Permit Requirements: Cleaning process would need to be evaluated under Rule 219 (1)(10) to determine exemption status.

655.3 SUMMARY OF SDCAPCD REQUIREMENTS

Permit Requirements: This source requires a permit unless exempt per Regulation II, Rule 11.

655.4 SUMMARY OF SJVUAPCD REQUIREMENTS

Permit Requirements: In general, if a process emits > 2 lbs/day of a pollutant, it is required to be permitted. If < 2 lbs/day, it may be exempted by Rule 2020.

Toxics: Dependent upon the solution in use and the associated emissions. See Appendix D for regulated HAPs and trigger levels.

Permit Conditions: Permit conditions for VOC or HAP emissions may include: throughput, daily emissions limits (DELs), VOC content limits for coatings. Also refer to specific permit conditions.

Regulations: Rule 2010--Permits Required, Rule 4001--New Source Performance Standards, Rule 4002--National Emissions Standards For Hazardous Air Pollutants, Rule 4661--Organic Solvents.

655.5 SUMMARY OF VCAPCD REQUIREMENTS

Permit Requirements: This source requires a Permit to Operate unless exempted by Regulation II, Rules 23.F.10.

Toxics: Refer to Appendix C.

Permit Conditions: If subject to a permit, refer to the individual permit conditions.

Regulations: The source is subject to Regulation IV, Rules 74.6, 74.6.1, 74.6.2, or 74.6.3.

APPENDIX A

I. SUBSTANCES IDENTIFIED AS TOXIC AIR CONTAMINANTS BY THE AIR RESOURCES BOARD, PURSUANT TO THE PROVISIONS OF AB 1807 AND AB 2728 (INCLUDES ALL HAZARDOUS AIR POLLUTANTS LISTED IN THE FEDERAL CLEAN AIR ACT AMENDMENTS OF 1990).

II. SUBSTANCES CURRENTLY UNDER REVIEW OR NOMINATED FOR IDENTIFICATION AS TOXIC AIR CONTAMINANTS.

III. SUBSTANCES WHICH ARE BEING EVALUATED FOR ENTRY INTO CATEGORY II (IIA OR IIB).

APPENDIX A

Toxic Air Contaminant Identification List
June 1996

I. Substances identified as Toxic Air Contaminants by the Air Resources Board, pursuant to the provisions of AB 1807 and AB 2728 (includes all Hazardous Air Pollutants listed in the Federal Clean Air Act Amendments of 1990).

Acetaldehyde
Acetamide
Acetonitrile
Acetophenone
2-Acetylaminofluorene
Acrolein
Acrylamide
Acrylic acid
Acrylonitrile
Allyl chloride
4-Aminobiphenyl
Aniline
o-Anisidine
*Asbestos
*Benzene (including benzene from gasoline)
Benzidine
Benzotrichloride
Benzyl chloride
Biphenyl
Bis(2-ethylhexyl)phthalate
Bis(chloromethyl)ether
Bromoform
*1,3-Butadiene
*Cadmium (met. cadmium cadmium compounds)
Calcium cyanamide
Caprolactam
Captan
Carbaryl
Carbon disulfide
*Carbon tetrachloride
Carbonyl sulfide
Catechol
Chloramben
Chlordane
Chlorine
*Chlorinated dioxins and dibenzofurans (15 species)
Chloroacetic acid
2-Chloroacetophenone
Chlorobenzene
Cresols/Cresylic acid (isomers and mixtures)
o-Cresol
m-Cresol
p-Cresol
Cumene
2,4-D, salts and esters
DDE
Diazomethane
Dibenzofurans
1,2-Dibromo-3-chloropropane
Dibutylphthalate
1,4-Dichlorobenzene(p)
3,3-Dichlorobenzidene
Dichloroethyl ether [Bis(2-chloroethyl)ether]
1,3-Dichloropropene
Dichlorvos
Diethanolamine
N,N-Dimethylaniline
Diethyl sulfate
3,3-Dimethoxybenzidene
Dimethyl aminoazobenzene
3,3-Dimethyl benzidene
Dimethyl carbamoyl chloride
Dimethyl formamide
1,1-Dimethyl hydrazine
Dimethyl phthalate
Dimethyl sulfate
4,6-Dinitro-o-cresol, and salts
2,4-Dinitrophenol
2,4-Dinitrotoluene
1,4-Dioxane (1,4-diethyleneoxide)
1,2-Diphenylhydrazine
Epichlorohydrin (1-chloro-2,3-epoxypropane)
1,2-Epoxybutane
Ethyl acrylate
Ethyl benzene
Ethyl carbamate (urethane)
Ethyl chloride (chloroethane)
*Ethylene dibromide (dibromoethane)
Ethylidene dichloride (1,1-dichloroethane)
*Formaldehyde
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexamethylene-1,6-diisocyanate
Hexamethylphosphoramide
Hexane
Hydrazine
Hydrochloric acid
Hydrogen fluoride (hydrofluoric Acid)
Hydroquinone
*Inorganic arsenic
Isophorone
Lindane (all isomers)
Maleic anhydride
Methanol
Methoxychlor
Methyl bromide (bromomethane)
Methyl chloride (chloromethane)
Methyl chloroform (1,1,1-trichloroethane)
Methyl ethyl ketone (2-butanone)
Methyl hydrazine
Methyl iodide (iodomethane)
Methyl isobutyl ketone (hexone)
Methyl isocyanate
Methyl methacrylate
Methyl tert butyl ether
4,4-Methylene bis(2-chloroaniline)
*Methylene chloride (dichloromethane)
Methylene diphenyl diisocyanate (MDI)
4,4-Methylenedianiline
Naphthalene
*Nickel and nickel compounds
Nitrobenzene
4-Nitrobiphenyl

APPENDIX A

Chlorobenzilate
*Chloroform
Chloromethyl methyl ether
Chloroprene
*Chromium VI
Ethylene thiourea
*Trichloroethylene
Phenol
Triethylamine
Phosphine
Vinyl acetate
Polychlorinated biphenyls (aroclors)
1,3-Propane sultone
Propionaldehyde
Propoxur (Baygon)
o-Xylenes
1,2-Propylenimine (2-methyl aziridine)
Quinoline
Quinone
Styrene
Styrene oxide
2,3,7,8-Tetrachlorodibenzo-p-dioxin
1,1,2,2-Tetrachloroethane
*Tetrachloroethylene (perchloroethylene)
Titanium tetrachloride
Toluene
2,4-Toluene diamine
2,4-Toluene diisocyanate
o-Toluidine
Toxaphene (chlorinated camphene)
1,2,4-Trichlorobenzene
1,1,2-Trichloroethane

*Ethylene dichloride
(1,2-dichloroethane)
Ethylene glycol
Ethylene imine (aziridine)
*Ethylene oxide
Parathion
Pentachlorophenol
2,4,6-Trichlorophenol
Phosgene
2,2,4-Trimethylpentane
Phthalic anhydride
Vinylidene chloride
Xylenes (isomers and mixture)
m-Xylenes
Propylene oxide

4-Nitrophenol
2-Nitropropane
N-Nitroso-N-methylurea
N-Nitrosodimethylamine
N-Nitrosomorpholine
Pentachloronitrobenzene (Quintobenzene)
2,4,5-Trichlorophenol
p-Phenylenediamine
Trifluralin
Phosphorus
Vinyl bromide
*Vinyl chloride (1,1-dichloroethylene)
beta-Propiolactone
Propylene dichloride (1,2-dichloropropane)
p-Xylenes
o Antimony Compounds
o Arsenic Compounds (inorganic including arsine)
o Beryllium Compounds
o Cadmium Compounds
o Chromium Compounds
o Cobalt Compounds
o Coke Oven Emissions
o Cyanide Compounds[1]
o Glycol Ethers[2]
o Lead Compounds
o Manganese Compounds
o Mercury Compounds
o Fine Mineral Fibers[3]
o Nickel Compounds
o Polycyclic Organic Matter[4]
o Radionuclides (including radon)[5]
o Selenium Compounds

* Substances which have already been identified by the Board as TACs and which have potency numbers developed by the OEHHA and SRP.

APPENDIX A

II. Substances currently under review or nominated for review for identification as Toxic Air Contaminants.

A. Substances already in the review process.

Diesel exhaust	Inorganic lead

B. Substances nominated for review.

Dialkylnitrosamines	Environmental Tobacco Smoke

III. Substances which are being evaluated for entry into Category II (IIA or IIB). Factors considered in this evaluation include carcinogenic and noncarcinogenic health effects, emissions and exposure in California.

Aluminum	Gasoline vapors
Ammonia	Glutaraldehyde
Ammonium nitrate	Hexachlorocyclohexanes
Ammonium sulfate	Hydrogen sulfide
Barium compounds	Isopropyl alcohol
Benzoyl chloride	4,4'-Isopropylidenediphenol
Bis(2-ethylhexyl)adipate	Molybdenum trioxide
Bromine compounds (inorganic)	n-Butyl alcohol
Butyl acrylate	Nitric acid
Butyl benzyl phthalate	Nitrilotriacetic acid
Carbon black extracts	Peracetic acid
Chlorinated fluorocarbons	2-Phenylphenol
Chlorine dioxide	Phosphoric acid
Chlorophenols	Propene
Copper compounds	sec-Butyl alcohol
Creosotes	Silver Compounds
Crystalline silica	Sodium hydroxide
Cumene hydroperoxide	Sulfuric acid
Cyclohexane	Terephthalic acid
Decabromodiphenyl oxide	tert-Butyl alcohol
Diaminotoluene (mixed isomers)	Thiourea
Dicofol	1,2,4-Trimethylbenzene
	Zinc Compounds

Note: For all listings above which contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e, antimony, arsenic, etc.) as part of that chemical's infrastructure.

[1] X'CN where X=H' or any other group where a formal dissociation may occur. For example, KCN or $Ca(CN)_2$

[2] includes mono- and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol ($R(OCH_2CH_2)_n$ -OR' where

n = 1,2 or 3

R = alkyl or aryl groups

R = R,H, or groups which, when removed, yield glycol ethers with the structure; $R(OCH_2CH)_n$-OH. Polymers are excluded from the glycol category.

[3] includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[4] includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100^{o} C.

[5] a type of atom which spontaneously undergoes radioactive decay.

APPENDIX B

Printed Circuit Boards

EPA METHOD 9 INSTRUCTIONS FOR OPACITY READINGS

APPENDIX B

EMISSION MEASUREMENT TECHNICAL INFORMATION CENTER
NSPS TEST METHOD

Prepared by **Emission Measurement Branch**
EMTIC TM-009
Technical Support Division, OAQPS, EPA
October 25, 1990

Method 9 - Visual Determination of the Opacity of Emissions from Stationary Sources

INTRODUCTION

(a) Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The methods includes procedures for the training and certification of observers and procedures to be used in the field for determination of plume opacity.

(b) The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

(c) Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer and can affect the ability of the observer to assign accurately opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. Accordingly, the opacity of a plume viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive

error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be incorrectly cited for a violation of opacity standards as a result of observer error.

(d) Studies have been undertaken to determine the magnitude of positive errors made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity. (Note: For a set, positive error = average opacity determined by observers' 25 observations -average opacity determined from transmissometer's 25 recordings.)

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

(e) The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. PRINCIPLE AND APPLICABILITY

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

APPENDIX B

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to ? 60.11(b) and for visually determining opacity of emissions.

2. PROCEDURES

The observer qualified in accordance with Section 3 of this method shall use the following procedures for visually determining the opacity of emissions.

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140E sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction and, when observing opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

2.2 Field Records. The observer shall record the name of the plant, emission location, facility type, observer's name and affiliation, and the date on a field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached Steam Plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached Steam Plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording Observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9-2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9-1 for an example.)

3. QUALIFICATION AND TESTING

3.1 Certification Requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in Section 3.2. Smoke generators used pursuant to Section 3.2 shall be equipped with a smoke meter which meets the requirements of Section 3.3. The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification Procedure. The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes-generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the

complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke Generator Specifications. Any smoke generator used for the purposes of Section 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display in-stack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 91. The smoke meter shall be calibrated as prescribed in Section 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds "l percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

TABLE 9-1 - SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

Parameter Specification

a. Light Source Incandescent lamp operated at nominal rated voltage

b. Spectral reponse of photocell Photopic (daylight spectral response of the human eye - Citation 3)

c. Angle of view 15B maximum total angle

d. Angle of projection 15B maximum total angle

e. Calibration error "3% opacity, maximum

f. Zero and span drift "1% opacity, 30 minutes

g. Response time 5 seconds

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke Meter Evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light Source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within "5 percent of the nominal rated voltage.

3.3.2.2 Spectral Response of Photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity in (b) of Table 91.

3.3.2.3 Angle of View. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15E. The total angle of view may be calculated from: $Q = 2 \tan^{-1} (d/2L)$, where Q = total angle of view; d = the sum of the photocell diameter + the diameter of the limiting aperture; and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of Projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15E. The total angle of projection may be calculated from: $Q = 2 \tan^{-1} (d/2L)$, where Q = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration Error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to Section 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibrated

within 2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and Span Drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response Time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. BIBLIOGRAPHY

1. Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

2. Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, NC, APTD-1100, August 1972, pp. 4.1-4.36.

3. Condon. E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., New York, NY, 1958, Table 3.1, p. 6-52.

APPENDIX C

Printed Circuit Boards

VENTURA COUNTY APCD
NEW SOURCE REVIEW TOXIC POLLUTANTS POLICY

APPENDIX C

COUNTY OF VENTURA
RESOURCE MANAGEMENT AGENCY/APCD
Memorandum

TO: Engineering Staff DATE: February 12, 1992

FROM: Karl E. Krause, Manager

SUBJECT: New Source Review Toxic Pollutants Policy

Background

The Ventura County Air Pollution Control District has no new source review rule for toxic air pollutants. The permit processing staff, however, cannot issue a permit unless the applicant demonstrates that the proposed new, modified, replacement or relocated emissions unit can operate in compliance with all applicable regulations including Rule 51, the District public nuisance rule.

The object of this policy, therefore, is to define how the permit processing staff will determine if a new, modified, replacement or relocated emissions unit which emits toxic air pollutants can operate in compliance with the District public nuisance rule.

Policy

An applicant for any new, modified, replacement or relocated emissions unit which will emit any of the pollutants, or burn any of the fuels, in the attached table in the amounts listed in the table will be required to prepare a health risk assessment as part of the permit application. In determining whether a health risk assessment will be required and in conducting any required health risk assessment, only emission increases resulting from the subject emissions units will be considered. An applicant, however, that the District permitting staff determine is eligible to receive a portable facility permit will not be required to submit a health risk assessment.

An applicant required to submit a health risk assessment may submit a screening level health risk assessment or a more refined health risk assessment. The health

risk assessment should be conducted according to the most recent version of the health risk assessment guidelines for the toxic “Hot Spots program. At the request of an applicant, the District staff will conduct the health risk assessment for non-complex emissions units for an hourly rate fee pursuant to Rule 42.D.

If the results of the health risk assessment indicate that the additional carcinogenic risk associated with the emissions increase from the new, modified, replacement or relocated emissions units is less than 1 in a million, and the acute and chronic hazard indices are less than 0.5, then no further action will be required.

If the health risk assessment demonstrates that the carcinogenic risk is greater than 1 in a million, or either the acute or chronic hazard index is greater than 0.5, the District staff will work with the applicant to reduce the risk to an acceptable level.

If the carcinogenic risk cannot be reduced to 10 in a million or less, and both the acute and chronic hazard indices to 1 or less, the application will be denied.

For the purposes of this policy, all risk numbers will be expressed as one significant figure.

APPENDIX C

New Source Review Toxic Pollutants Table

Natural Gas - Ext. Comb.	> 500 MMCF/year
Natural Gas - Int. Comb.	> 2 MMCF/year
Fuel Oil Combustion	> 2 kgal/year
Landfill Gas Combustion	> 0 MMCF/year
Digester Gas Combustion	> 0 MMCF/year
Incineration	> 0 lb/year
Carbon Tetrachloride	> 10 lb/year
Trichloroethylene	> 300 lb/year
Methylene Chloride	> 600 lb/year
Perchloroethylene	> 1000 lb/year
1, 1, 1-Trichloroethane	> 10 tons/year
Benzene	>20 lb/year
Gasoline Vapors	>700 lb/year
Xylenes	> 8 tons/year
1,3-Butadiene	> 2 lb/year
Isocyanates	> 6 lb/year
Vinyl Chloride	> 8 lb/year
Ethylene Dibromide	> 8 lb/year
Ethylene Dichloride	> 30 lb/year
Formaldehyde	> 50 lb/year
Chloroform	> 30 lb/year
Methyl Bromide	> 300 lb/year
Chlorine	> 400 lb/year
Hydrogen Chloride	> 400 lb/year
Hydrogen Fluoride	> 400 lb/year
Asbestos	> 0 lb/year
Arsenic	> 0 lb/year
Beryllium	> 0 lb/year
Cadmium	> 0 lb/year
Hexavalent Chromium	> 0 lb/year
Mercury	> 1 lb/year
Nickel	> 2 lb/year
Lead	> 9 lb/year
Manganese	> 60 lb/year

APPENDIX D

Printed Circuit Boards

PLEASE CONTACT SAN JOAQUIN VALLEY UNIFIED APCD FOR CURRENT DE MINIMIS LEVELS FOR HAZARDOUS AIR POLLUTANTS

APPENDIX E

Printed Circuit Boards

BAY AREA AQMD TOXIC AIR CONTAMINANT TRIGGER LEVELS

APPENDIX E

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

TOXIC AIR CONTAMINANT TRIGGER LEVELS

The following is a list of toxic air contaminants and their trigger levels. These levels are used by the BAAQMD in evaluating air contaminat emissions and risk levels of facilities within the San Francisco Bay Area.

Compound +	CAS Number	Trigger Level (lb/year)
Acetaldehyde	75070	7.20E+01
Acrolein	107028	3.90E+00
Acrylamide	79061	1.50E-01
Acrylonitrile	107131	6.70E-01
Allyl chloride	107051	1.93E+02
Ammonia	7664417	1.93E+04
Arsenic and arsenic compounds (inorganic)	7440382*	2.40E-02
Asbestos	1332214	3.00E-03
Benzene	71432	6.70E+00
Benzidine (and its salts)	92875*	1.40E-03
Benzyl chloride (see chlorotoluenes)	100447	
Beryllium and beryllium compounds	7440417*	1.50E-02
Bis(chloromethyl)ether	542881	1.50E-02
Bromine and bromine compounds (inorganic)	7726956*	3.28E+02
Butadiene, 1,3-	106990	1.10E+00
Butyl alcohol, tert-	75650	1.37E+05
Cadmium and cadmium compounds	7440439*	4.60E-02
Carbon disulfide	75150	1.43E+04
Carbon tetrachloride	56235	4.60E+00
Chlorinated dibenzodioxins and dibenzofurans (TCDD equivalent)	1746016*	1.20E-06
Chlorine	7782505	1.37E+03
Chlorobenzene	108907	1.35E+04
Chlorofluorocarbons	*	1.35E+05
Chloroform	67663	3.60E+01
Chlorophenol, 2-	108430	3.47E+03
Chloropicrin	76062	3.28E+02
Chloroprene	126998	1.50E+03
Chlorotoluenes	100447*	2.32E+03

APPENDIX E

Compound +	CAS Number (lb/year)	Trigger Level
Chromium (hexavalent) and chromium (hexavalent) compounds	18540299*	1.40E-03
Copper and copper compounds	7440508*	4.63E+02
Cresol	1319773	3.47E+04
Dibromo-3-chloropropane,1,2- (DBCP)	96128	9.70E-02
Dichlorobenzene, 1,4-	106467	6.80E+01
Dichlorobenzidene, 3,3'-	91941	5.60E-01
Dichloroethylene, 1,1- (see vinylidene chloride)		
Diethylaminoethanol	100378	2.12E+04
Diethylhexylphthalate (DEHP)	117817	8.10E+01
Dimethyl phthalate	131113	2.32E+03
Dimethylamine	124403	3.86E+02
Dioctyl phthalate	117840	2.32E+03
Dioxane, 1,4-	123911	2.50E+01
Epichlorohydrin	106898	8.30E+00
Ethyl acetate	141786	6.56E+05
Ethyl acrylate	140885	9.26E+03
Ethyl alcohol (ethanol)	64175	8.69E+05
Ethyl chloride	75003	1.93E+06
Ethyl benzene	100414	1.93E+05
Ethylene dibromide (1,2-dibromoethane)	106934	2.70E+00
Ethylene dichloride (1,2-dichloroethane)	107062	9.70E+00
Ethylene oxide	75218	2.10E+00
Formaldehyde	50000	3.30E+01
Freons (see Chlorofluorocarbons)		
Glutaraldehyde	111308	3.28E+02
Glycol ethers:		
2-Ethoxy ethanol (cellosolve; ethylene glycol monoethyl ether)	110805	3.86E+04
2-Ethoxyethyl acetate (cellosolve acetate; ethylene glycol monoethyl ether acetate)	111159	1.24E+04
2-Methoxy ethanol (methyl cellosolve; ethylene glycol monomethyl ether)	109864	3.86E+03
2-Methoxyethyl acetate (methyl cellosolve acetate; ethylene glycol monomethyl ether acetate)	110496	1.10E+04
2-Butoxy ethanol (Butyl cellosolve; ethylene glycol monobutyl ether)	111762	3.86E+03
Hexachlorobenzene	118741	3.90E-01
Hexachlorocyclohexanes	58899*	1.80E-01
Hexachlorocyclopentadiene	77474	4.63E+01
Hexane, n-	110543	8.30E+04
Hydrazine	302012	3.90E-02

APPENDIX E

Compound +	CAS Number	Trigger Level (lb/year)
Hydrogen bromide (hydrobromic acid)	10035106	4.63E+03
Hydrogen chloride	7647010	1.35E+03
Hydrogen cyanide	74908	1.35E+04
Hydrogen fluoride	7664393	1.14E+03
Hydrogen sulfide	7783064	8.11E+03
Isocyanates:		
Methylene-bis-phenyl isocyanate	101688	1.83E+01
Methyl isocyanate	624839	6.95E+01
Toluene diisocyanates	26471625*	1.83E+01
Isophorone	78591	6.56E+04
Isopropyl alcohol	67630	4.44E+05
Lead, inorganic, and lead compounds	7439921*	2.90E+01
Maleic anhydride	108316	4.63E+02
Manganese and manganese compounds	7439965*	7.70E+01
Mercury and mercury compounds (inorganic)	7439976*	5.79E+01
Methyl alcohol (methanol)	67561	1.20E+05
Methyl bromide	74839	1.16E+03
Methyl chloroform (1,1,1-TCA)	71556	6.18E+04
Methyl mercury	593748	1.93E+02
Methyl methacrylate	80626	1.89E+05
Methylene chloride	75092	1.90E+02
Methylene dianiline and its dichloride, 4,4'-	101779*	3.67E+02
Methylethylketone (MEK)	78933	1.49E+05
Methylpyrrolidone, N-	872504	1.83E+05
Naphthalene	91203	2.70E+02
Nickel and nickel compounds	7440020*	7.30E-01
Nitric acid	7697372	2.34E+03
Nitrobenzene	98953	3.28E+02
Nitropropane, 2-	79469	3.86E+03
Nitrosodiethylamine, N-	55185	1.90E-02
Nitrosodimethylamine, N-	62759	4.20E-02
Nitrosodi-n-butylamine, N-	924163	6.20E-02
Nitrosodi-n-propylamine, N-	621647	9.70E-02
Nitrosodiphenylamine, p-	86306	7.30E+01
Nitrosomethylethylamine, N-	10595956	3.10E-02
Nitrosopyrrolidine, N-	930552	3.30E-01
PAHs (including but not limited to):	*	
Benz[a]anthracene	56553	4.30E-02
Benzo[b]fluoroanthene	205992	4.30E-02
Benzo[k]fluoroanthene	205823	4.30E-02
Benzo[a]pyrene	50328	4.30E-02
Dibenz[a,h]anthracene	53703	4.30E-02

APPENDIX E

Compound +	CAS Number (lb/year)	Trigger Level
Indeno[1,2,3-cd]pyrene	193395	4.30E-02
PCBs (polychlorinated biphenyls)	1336363*	7.00E-03
Pentachlorophenol	87865	4.20E+01
Perchloroethylene (tetrachloroethylene)	127184	3.30E+01
Phenol	108952	8.69E+03
Phosgene	75445	1.83E+02
Phosphine	7803512	1.93E+03
Phosphoric acid	7664382	4.63E+02
Phosphorus (white)	7723140	1.39E+01
Phthalic anhydride	85449	1.35E+06
Propylene oxide	75569	5.20E+01
Selenium and selenium compounds	7782492*	9.65E+01
Sodium hydroxide	1310732	9.26E+02
Styrene monomer	100425	1.35E+05
Tetrachlorophenols	25167833*	1.70E+04
Tetrahydrofuran	109999	2.70E+05
Toluene	108883	3.86E+04
Trichlorobenzene, 1,2,4-	120821	1.83E+04
Trichloroethane, 1,1,1- (see Methyl chloroform)		
Trichloroethylene	79016	9.70E+01
Trichlorophenol, 2,4,6-	88062	9.70E+00
Urethane (ethyl carbamate)	51796	6.60E-01
Vapam (sodium methyldithiocarbamate)	137428	2.20E+04
Vinyl chloride	75014	2.50E+00
Vinylidene chloride	75354	6.18E+03
Xylenes	1330207*	5.79E+04
Zinc and zinc compounds	7440666*	6.76E+03

+ Compounds listed are established by CARB as toxic air contaminants.

* — This is a chemical compound group. If a CAS number is listed, itrepresents only a single chemical within the chemical class. (For metalliccompounds, the CAS number of the elemental form is listed; for other compounds,the CAS number of a predominant compound in the group is given.)

If the emissions from a source are less than the listed trigger-levels,it is assumed that the source would not fail a risk screen. If the emissionsare equal or greater than one or more of the trigger-levels, a risk screenshould be completed to determine the source's exemption status.

APPENDIX F

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APPENDIX G

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BILL OF RIGHTS FOR ENVIRONMENTAL PERMIT APPLICANTS

APPENDIX G

BILL OF RIGHTS FOR ENVIRONMENTAL PERMIT APPLICANTS (Revised 8/29/96)

California Environmental Protection Agency (Cal/EPA) recognizes that many complex issues must be addressed when pursuing reforms of environmental permits and that significant challenges remain. We have initiated reforms and intend to continue the effort to make environmental permitting more efficient, less costly, and to ensure that those seeking permits receive timely responses from the boards and departments of the Cal/EPA. To further this goal, Cal/EPA endorses the following precepts that form the basis of a permit applicant s Bill of Rights:

1. Permit applicants have the right to assistance in understanding regulatory and permit requirements. All Cal/EPA programs maintain an Ombudsman to work directly with applicants. Permit Assistance Centers located throughout California have permit specialists from State, regional, and local agencies to identify permit requirements and assist in permit processing.

2. Permit applicants have the right to know the projected fees for review of applications, how any costs will be determined and billed, and procedures for resolving any disputes over fee billinqs.

3. Permit applicants have the right of access to complete and clearly written guidance documents that explain the regulatory requirements. Agencies must publish a list of all information required in a permit application and of criteria used to determine whether the submitted information is adequate.

4. Permit applicants have the right of timely completeness determinations for their applications. In general, agencies notify the applicant within 30 days of any deficiencies or determine that the application is complete. California Environmental Quality Act (CEQA) and public hearing requests may require additional information.

5. Permit applicants have the right to know exactly how their applications are deficient and what further information is needed to make their applications complete. Pursuant to California Government Code Section 65944, after an application is accepted as complete, an agency may not request any new or additional information that was not specified in the original application.

6. Permit applicants have the right of a timely decision on their permit application. The agencies are required to establish time limits for permit reviews.

7. Permit applicants have the right to appeal permit review time limits by statute or administratively that have been violated without good cause. For state environmental agencies, appeals are made directly to the Cal/EPA Secretary or to a specific board. For local environmental agencies, appeals are generally made to the local governing board or, under certain circumstances, to Cal/EPA. Through this appeal, applicants may obtain a set date for a decision on their permit and in some cases a refund of all> 60 lb/year application fees (ask boards and departments for details).

8. Permit applicants have the right to work with a single lead agency where multiple environmental approvals are needed. For multiple permits, all agency actions can be consolidated under a lead agency. For site remediation, all applicable laws can be administered through a single lead agency.

9. Permit applicants have the right to know who will be reviewing their application and the time required to complete the full review process. Cal/EPA Regulatory Reform Improvement Initiative

GLOSSARY

AAQS (Ambient Air Quality Standards): Health and welfare based standards for clean outdoor air which identify the maximum acceptable average concentrations of air pollutants during a specified period of time.

AB 1807 (Tanner): A California State law (Health and Safety Code Section 39650 et seq.) which became effective in January of 1984 and established the framework for California's toxic air contaminant identification and control program.

Acute Health Effect: An adverse health effect which occurs over a relatively short period of time (e.g., minutes or hours).

Additive Process: A process for obtaining conductive patterns by the selective deposition of conductive material on clad or unclad base material.

ATCM (Airborne Toxic Control Measure): A type of control measure, adopted by the ARB (Health and Safety Code Section 39666 et seq.), which reduces emissions of toxic air contaminants from nonvehicular sources.

Air Pollutants: Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects on humans, animals, vegetation, and/or materials.

Air Quality Simulation Model: A mathematical relationship between emissions and air quality which simulates the transport, dispersion, and transformation of compounds emitted into the air.

Air Toxics: A generic term referring to a harmful chemical or group of chemicals in the air. Typically, substances that are especially harmful to health, such as those considered under EPA's hazardous air pollutant program or California's AB 1807 toxic air contaminant program, are considered to be air toxics. Technically, any compound that is in the air and has the potential to produce adverse health effects is an air toxic.

Air Toxics "Hot Spots" Information and Assessment Program (AB 2588): A California program (Health and Safety Code Section 44300 et seq.) which requires certain stationary sources to report the type and quantity of specific toxic substances they routinely release into the air. The program identifies high priority facilities and requires facilities posing significant risks to notify all exposed individuals.

GLOSSARY

Ambient Air: The air occurring at a particular time and place outside of structures. Often used interchangeably with outdoor air.

Annular Ring: That portion of conductive material completely surrounding a hole.

AOI (Automated Optical Inspection): Computer-based inspection devices that acquire an image of an in-process or completed printed wiring board and locate defects such as broken traces, excess copper that may cause shorts, over- or under-etching, and misregistration of holes to circuit pattern, among other defects. The most common application of AOI is the inspection of inner layers after etch.

APCD (Air Pollution Control District): A county agency with authority to regulate stationary, indirect, and area sources of air pollution (e.g., power plants, highway construction, and housing developments) within a given county, and governed by a district air pollution control board composed of the elected county supervisors. (Compare AQMD).

AQMD (Air Quality Management District): A group of counties or portions of counties, or an individual county specified in law with authority to regulate stationary, indirect, and area sources of air pollution within the region and governed by a regional air pollution control board comprised mostly of elected officials from within the region. (Compare APCD).

ARB (California Air Resources Board): The State's lead air quality agency consisting of a nine-member Governor-appointed board. It is responsible for attainment and maintenance of the State and federal air quality standards, and is fully responsible for motor vehicle pollution control. It oversees county and regional air pollution management programs.

Array: A group of elements or circuits (or circuit boards) arranged in rows and columns on a base material.

Artwork: An accurately scaled configuration used to produce the artwork master or production master.

Artwork Master: The photographic film or glass plate that embodies the image of the PCB pattern, usually on a 1:1 scale.

GLOSSARY

Aspect Ratio: The ratio of the PCB thickness to the diameter of the smallest hole.

Assembly: A number of parts, subassemblies, or any combination thereof joined together.

Atmosphere: The gaseous mass or envelope surrounding the earth.

Attainment Area: A geographic area which is in compliance with the National and/or California Ambient Air Quality Standards (NAAQS or CAAQS).

Automatic Test Equipment: Equipment that automatically analyzes functional or static parameters in order to evaluate performance.

B-Stage: Also referred to as "prepreg." Semi-cured stage of base printed wiring board substrate. B-stage material is used in lamination. During the laminations cycle, the B-stage is cured to C-stage.

B-Stage Resin: A thermosetting resin that is in an intermediate state of cure.

BACT (Best Available Control Technology): The most up-to-date methods, systems, techniques, and production processes available to achieve the greatest feasible emission reductions for given regulated air pollutants and processes. BACT is a requirement of NSR (New Source Review) and PSD (Prevention of Significant Deterioration).

Base Copper: The thin copper foil portion of a copper-clad laminate for PCBs. It can be present on one or both sides of the board.

Base Material: The insulating material upon which a conductive pattern may be formed. It may be rigid or flexible or both. It may be a dielectric or insulated metal sheet.

Base Material Thickness: The thickness of the base material excluding metal foil or material deposited on the surface.

Bed of Nails Fixture: A test fixture consisting of a frame and a holder containing a field of spring-loaded pins that make electrical contact with a planar test object (i.e., a PCB).

GLOSSARY

Blind Via: A via that is drilled from the surface of a printed wiring board and terminates within the substrate. Blind vias, when plated with copper, provide interconnection for some, but not all, of the layers of a multilayer printed wiring board. Blind vias are usually employed to conserve space on high-density layers that do not require connection to the via.

Blister: A localized swelling and separation between any of the layers of a laminated base material, or between base material or conductive foil. It is a form of delamination.

Bond Strength: The force per unit area required to separate two adjacent layers of a board by a force perpendicular to the board surface.

Bow: The deviation from flatness of a board characterized by a roughly cylindrical or spherical curvature such that if the board is rectangular, its four corners are in the same place.

Buried Via: A via that is drilled through inner layers prior to lamination. Buried vias provide inter-connection for a pair of inner layers (such as layers 2 and 3 on a 4-layer printed wiring board). When the printed wiring board is laminated, the via is buried by the surface layers.

C-Stage: The fully cured epoxy-resin substrate of standard printed wiring board base material.

CAAQS (California Ambient Air Quality Standard): A legal limit that specifies the maximum level and time of exposure in the outside air for a given air pollutant and which is protective of human health and public welfare (Health and Safety Code 39606b). CAAQSs are recommended by the California Office of Environmental Health Hazard Assessment and adopted into regulation by the Air Resources Board. CAAQS are the standards which must be met per the requirements of the California Clean Air Act.

CAD (Computer-aided Design): CAD, in the printed wiring board shop, usually refers to the manipulation of image data received from a design. The CAD department typically produces ready-to-image photo-tool files (for laser photoplotting) from raw design data files, numerical control files for drilling and routing, and test files for bare-board electrical testing and optical inspection.

CCAA (California Clean Air Act): A California law passed in 1988 which provides the basis for air quality planning and regulation independent of federal regulations. A major element of the Act is the requirement that local APCD/ AQMDs in violation of the CAAQS must prepare attainment plans which identify air quality problems, causes, trends, and actions to be taken to attain and maintain California's air quality standards by the earliest practicable date.

CEQA (California Environmental Quality Act): A California law which set forth a process for public agencies to make informed decisions on discretionary project approvals. The process impacts are associated with a proposed project. It requires environmental impacts associated with a proposed project to be eliminated or reduced, and that air quality mitigation measures have been implemented.

Chamfer: A broken corner to eliminate an otherwise sharp edge.

CFCs (Chlorofluorocarbons): Any of a number of substances consisting of chlorine, fluorine, and carbon. CFCs are used for refrigeration, foam packaging, solvents, and propellants. They are proven to cause depletion of the atmosphere's ozone layer.

Chronic Health Effect: An adverse health effect which occurs over a relatively long period of time (e.g., months or years).

Circuit: The interconnection of a number of devices in one or more closed paths to perform a desired electrical or electronic function.

Circuitry Layer: A layer of a printed board containing conductors, including ground and voltage planes.

Clad or Cladding: A relatively thin layer or sheet of metal foil that is bonded to a laminate core to form the base material for printed circuits.

CTSA (Cleaner Technologies Substitutes Assessment): The CTSA is an analytical tool developed by EPA's DFE Program for use by industry and other interested parties; it is normally carried out on one use cluster chosen from the Use Cluster Profile. The CTSA is intended to provide a flexible format for systematically comparing trade-off issues associated with traditional and alternative chemicals, processes, and technologies. For each chemical, process, or

technology, the cost, performance, environmental and health risks, environmental releases, energy impacts, and resource conservation implications are evaluated. The goal of the CTSA is to allow for an informed decision about which alternative is best for a particular situation.

Conductor: A thin conductive area on a PCB surface or internal layer usually composed of lands (to which component leads are connected) and paths (traces).

Conductor Spacing: The distance between adjacent edges (not centerline to centerline) of isolated conductive patterns in a conductor layer.

Conductor Thickness: The thickness of the conductor including all metallic coatings.

Congestion Management Program: A state mandated program (Government Code Section 65089a) that requires each county to prepare a plan to relieve congestion and reduce air pollution.

Criteria Air Pollutant: An air pollutant for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set. Examples include: lead, ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM-10.

Deburring: Process of removing burrs after PCB drilling.

Defect: Any nonconformance to specified requirements by a unit or product.

Definition: The fidelity of reproduction of pattern edges, especially in a printed circuit relative to the original master pattern.

Design Rule: Guidelines that determine automatic conductor routing behavior with respect to specified design parameters.

Design Rule Checking: The use of a computer program to perform continuity verification of all conductor routing in accordance with appropriate design rules.

Desmear: A process designed to remove epoxy-resin smear from inner layer copper interfaces. Smear occurs during drilling.

Desmear: The removal of friction-melted resin and drilling debris from a hole wall.

Dewetting: A condition that results when molten solder has coated a surface and then receded, leaving irregularly shaped mounds separated by areas covered with a thin solder film and with the base material not exposed.

DfE (Design for the Environment): With an uncapitalized "f", DfE typically refers to the U.S. EPA DfE projects and staff. With a capital "F", it is generally recognized as the more general concept of design for the environment. DFE practices are designed to be comprehensive, multidisciplinary approaches to integrating environmental concerns and constraints into products and process design procedures. DFE, in fact, marks the transition of the environmental function within firms from overhead to strategic.

Digitizing: The converting of feature locations on a flat plane to a digital representation in X-Y coordinates.

Dimensional Stability: A measure of the dimensional change of a material that is caused by factors such as temperature changes, humidity changes, chemical treatment, and stress exposure.

Double-sided: A printed wiring board that has two layers of circuitry, one on each side of the board. Less complex to manufacture than a multilayer printed wiring board and several of the process steps (desmear, oxide, lamination) are not required.

Double-Sided Board: A printed board with a conductive pattern on both sides.

Dry-Film Resists: Coating material specifically designed for use in the manufacture of printed circuit boards and chemically machined parts. They are suitable for all photomechanical operations and are resistant to various electroplating and etching processes.

Dry-Film Solder Mask: Coating material (dry-film resist) applied to the printed circuit board via a lamination process to protect the board from solder or plating.

GLOSSARY

Dwell Time: As used in this text, dwell time is the time that a rack of printed wiring boards resides in a process bath or rinse tank.

Electroless Copper: A thin layer of copper deposited on the plastic or metallic surface of a PCB from an autocatalytic plating solution (without the application of electrical current).

Electroless Plating: Plating that proceeds without an external electricity source. A reduction of metal ions is accomplished with a chemical reducing agent (such as formaldehyde in electroless copper).

Electroplating: The electrodeposition of an adherent metal coating on a conductive object. The object to be plated is placed in an electrolyte and connected to one terminal of a D.C. voltage source. The metal to be deposited is similarly immersed and connected to the other terminal.

Electrowinning: A common metal recovery technology. Essentially electroplating, electrowinning is employed to electrolytically recover metal from wastewater through electrolysis. Large cathodes, and other design strategies are employed to win metal ions from dilute waste streams. Metal is recovered on cathodes for reuse or sold as scrap. The most common application is on drag-out tanks, where the fluid is continuously recycled through the electrowinner and a low concentration of metal is maintained (rather than the steadily rising concentration that would otherwise occur in a still rinse).

Emission Inventory: An estimate of the amount of pollutants emitted from mobile and stationary sources into the atmosphere over a specific period such as a day or a year.

Emission Offset (also known as an emission-trade-off)**:** A rule-making concept whereby approval of a new or modified stationary source of air pollution is conditional on the reduction of emissions from other existing stationary sources of air pollution. These reductions are required in addition to reductions required by BACT.

Emission Standard: The maximum amount of a pollutant that is allowed to be discharged from a polluting source such as an automobile or smoke stack.

EPA (Environmental Protection Agency): The United States agency charged with setting policy and guidelines, and carrying out legal mandates for the protection of national interests in environmental resources.

Epoxy: A family of thermosetting resins used in the packaging of semiconductor devices. Epoxies form a chemical bond to many metal surfaces.

Etchant: In printed wiring board manufacture, a chemical that oxidizes metallic copper. Etchants are used to remove relatively thick layers (0.7 to 2.8 or more mils) of copper.

Etchback: A process by which an amount of printed wiring board substrate material (glass and epoxy, but not copper) is dissolved or otherwise removed from the walls of drilled holes. The purpose of etchback is to expose a greater inner layer copper surface area for interconnection with subsequently plated copper.

Etching: The chemical, or chemical and electrolytic, removal of unwanted portions of conductive materials.

Etch-resist: A substance unaffected by an etchant that is selectively applied over copper to protect the copper from the etchant. After etching, only the copper under the etch-resist remains on the board. Etch-resists may be organic (photoresists) or metallic (tin, tin-lead, nickel-gold).

FCAA (Federal Clean Air Act): A federal law passed in 1970 and amended in 1977 and 1990 which forms the basis for the national air pollution control effort. Basic elements of the Act include national ambient air quality standards for major air pollutants, air toxics standards, acid rain control measures, and enforcement provisions.

FIP (Federal Implementation Plan): In the absence of an approved State Implementation Plan (SIP), a plan prepared by the EPA which provides measures that non-attainment areas must take to meet the requirements of the Federal Clean Air Act.

FR-4: A designation for a flame retardant that contains bromide.

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Fugitive Dust: Dust particles which are introducted into the air through certain activities such as soil cultivation, off-road vehicles, or any vehicles operating on open fields or dirt roadways.

Greenhouse Effect: The warming effect of the earth's atmosphere on the earth. Light energy from the sun which passes through the earth's atmosphere is absorbed by the earth's surface and re-radiated into the atmosphere as heat energy. The heat energy is then trapped by the atmosphere, creating a situation similar to that which occurs in a greenhouse or a car with its windows rolled up. Many scientists believe that the emission of CO2 and other gases into the atmosphere may increase the greenhouse effect and contribute to global warming.

Hazardous Air Pollutant (HAP): An air pollutant considered by EPA to be particularly hazardous to health. Emission sources of hazardous air pollutants are identified by EPA, and emission standards are set accordingly.

Hole Pattern: The arrangement of all holes in a printed board with respect to a reference point.

Image Transfer: The series of processes by which an image of a circuit layer is transferred from film, glass, or data files to a copper layer of a printed wiring board. Image transfer is accomplished differently for both inner and outer layers. For inner layers, print-and-etch is most common, while for outer layers, print-pattern plate-etch is typical. Other methods exist.

Immersion Plating: Similar to electroless plating except that the reduction of metal ions in the plating solution is accomplished by the oxidization of the metal on the part being plated, rather than by a reducing agent in the solution. With immersion plating, therefore, the metal on the part is displaced- not coated- by metal ions in the solution and the process is self-limiting. When none of the original metal on the part remains in contact with the solution, the process stops. Only thin metal layers can be so plated, for example, for immersion gold, only a few microinches are possible.

Insulation Resistance: The electrical resistance of an insulating material that is determined under specific conditions between any pair of contacts, conductors, or grounding devices in various combinations.

KGB: Known good board or assembly. Also known as a "golden" board.

Laminate Thickness: Thickness of the metal-clad base material, single or double sided, prior to any subsequent processing.

Lamination: In printed wiring board manufacturing, lamination usually refers to the assembling of the layers of a multilayer panel in a press.

Land: A pad or land is the end of a circuit line or trace. A circuit feature designed to allow for component attachment (typically soldering), such as surface mount lands (usually rectangular) or lands surrounding plated through holes (usually circular). Typically, the pad or land is significantly wider than the rest of the circuit trace in order to approximately match the width of the component lead that will be attached to it.

Line: See Conductor.

Major Defect: A defect that is likely to result in failure of a unit or product by materially reducing its usability for its intended purpose.

Micro-etchant: In printed wiring board manufacturing, a chemical that oxidizes metallic copper. Micro-etchants remove 5 to 50 microinches of surface copper as a surface preparation or cleaning step.

Microsectioning: The preparation of a specimen of a material, or materials, that is to be used in metallographic examination. This usually consists of cutting out a cross-section followed by encapsulation, polishing, etching, and staining.

Minor Defect: A defect that is not likely to result in the failure of a unit or product or that does not reduce its usability for its intended purpose.

MCM (Multichip Module): Multichip modules consist of multiple bare IC chips mounted directly on a substrate, often quite similar to a small printed wiring board. This MCM can then be coated for protection from moisture and other hazards and used as is or is mounted on another printed wiring board as part of a larger printed wiring assembly.

Multilayer: A circuit with more than two layers of interconnected circuitry. In addition to the top and bottom surface layers, one or more layers are embedded within the substrate.

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Multilayer Printed Boards: Printed boards consisting of a number of separate conducting circuit planes separated by insulating materials and bonded together into relatively thin homogeneous constructions with internal and external connections to each level of the circuitry as needed.

Non-Attainment Area: A geographic area identified by the EPA and/or ARB as not meeting either NAAQS or CAAQS standards for a given pollutant.

NSR (New Source Review): A program used in development of permits for new or modified industrial facilities which are in a non-attainment area, and which emit non-attainment criteria air pollutants. The two major requirements of NSR are Best Available Control Technology and Emission Offset.

OEHHA (Office of Environmental Health Hazard Assessment): A department within the California Environmental Protection Agency that is responsible for evaluating chemicals for adverse health impacts and establishing safe exposure levels. OEHHA also assists in performing health risk assessments and developing risk assessment procedures for air quality management purposes.

OEM (Original Equipment Manufacturer): These companies manufacture printed wiring boards for use internally in their own electronic products.

Pad: A pad or land is the end of a circuit line or trace. A circuit feature designed to allow for component attachment (typically soldering), such as surface mount lands (usually rectangular) or lands surrounding plated through holes (usually circular). Typically, the pad or land is significantly wider than the rest of the circuit trace in order to approximately match the width of the component lead that will be attached to it.

Pad: The portion of the conductive pattern on printed circuits designated for the mounting or attachment of components. Also called “land.”

Panel: A rectangular sheet of base material or metal-clad material of predetermined size that is used for the processing of printed boards and, when required, one or more test coupons.

Panel Plating: Term used to describe the copper plating of an entire wiring board panel. No mask or plating resist is applied.

Pattern: The configuration of conductive and nonconductive materials on a panel or printed board. Also, the circuit configuration on related tools, drawings, and masters.

Pattern Plating: Term used to describe the copper plating of an entire printed wiring board panel that has area not included in the final circuit masked off with plating resist.

Permit: Written authorization from a government agency (e.g., an air quality management district) that allows for the construction and/or operation of an emissions generating facility or its equipment within certain specified limits.

Photographic Image: An image in a photomask or in an emulsion that is on a film or plate.

Photoplotting: A photographic process whereby an image is generated by a controlled light beam that directly exposes a light-sensitive material.

Photo Print: The process of forming a circuit pattern image by hardening a photosensitive polymeric material by passing light through a photographic film.

Pitch: Pitch refers to the distance from a point on a particular feature to the same point on the adjacent feature. Pitch, as used by the PWB industry, frequently defines the distance from the center of a circuit line (also called “trace”) to the center of the adjacent line. The thinner the line and space (or finer the pitch), the more lines can be placed on the PWB.

Plated Through Hole: A via or other drilled hole that is plated with copper. Since a printed wiring board substrate is not conductive (it consists of glass fibers and epoxy-resin), an electroless copper or other seed layer must be plated first before electrolytic copper can be applied. Copper is plated to a thickness of 0.001" on the walls of the hole, and this plating serves as a conductive pathway from layer to layer.

Plated Through Hole: A hole with plating on its walls that makes an electrical connection between conductive layers, external layers, or both, of a printed board.

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Pollution Prevention: The use of materials, processes, or practices to reduce, minimize, or eliminate the creation of pollutants or wastes. It includes practices that reduce the use of toxic or hazardous materials, energy, water, and/or other resources.

PSI (Pollutant Standards Index): A numerical index used for reporting severity of air pollution. The higher the index, the higher the level of pollutants and the greater likelihood of health effects.

Prepeg: Sheet material (e.g., glass fabric) impregnated with a resin cured to an intermediate stage (B-Stage resin).

Printed Board: The general term for completely processed printed circuit or printed wiring configurations. It includes single, double-sided, and multilayer boards, both rigid and flexible.

Printed Circuit: A conductive pattern that comprises printed components, printed wiring, or a combination thereof, all formed in a predetermined design and intended to be attached to a common base. (In addition, this is a generic term used to describe a printed board produced by any of a number of techniques).

PSD (Prevention of Significant Deterioration): A program used in development of permits for new or modified industrial facilities in an area that is already in attainment. The intent is to prevent an attainment area from becoming a non-attainment area. This program, like NSR, can require BACT and, if an AAQS is projected to be exceeded, Emission Offsets.

PWA (Printed Wiring Assembly): When electronic components have been mounted on the PWB, the combination of PWB and components is called a printed wiring assembly. This assembly is the basic building block for all larger electronic systems, from toys to toasters to telecommunications.

Printed Wiring Board (Printed Wiring Board): Also called PCB for Printed Circuit Board. A part manufactured from rigid base material upon which completely processed printed wiring has been formed.

Reflowing: The melting of an electrodeposited tin/lead followed by solidification. The surface has the appearance and physical characteristics of being hot-dipped.

Registration: The degree of conformity to the position of a pattern, or a portion thereof, a hole, or other feature to its intended position on a product.

Resin (Epoxy) Smear: Resin transferred from the base material onto the surface of the conductive pattern in the wall of a drilled hole.

Resist: Coating material used to mask or to protect selected areas of a pattern from the action of an etchant, solder, or plating.

Risk Assessment: An evaluation of risk which estimates the relationship between exposure to a harmful substance and the likelihood that harm will result for that exposure. Risk assessments are generally expressed as the estimated chance per million that a person, exposed over some period of time (e.g., a 70 year lifetime) and some specified concentration of exposure, will experience a certain effect.

Risk Management: An evaluation of the need for and feasibility of reducing risk. It includes consideration of magnitude of risk, available control technologies, and economic feasibility.

ROG (Reactive Organic Gas): A reactive chemical gas, composed of hydrocarbons, that may contribute to the formation of smog. Also sometimes referred to as Non-Methane Organic Compounds (NMOCs).

SCM (Suggested Control Measure): A technique recommended for local districts to use to control the emissions from certain stationary sources of air pollution.

Screen Printing: A process for transferring an image to a surface by forcing suitable media through a stencil screen with a squeegee.

Single-sided: A printed wiring board with only one layer of circuitry. Since no interconnection between layers is necessary, the electroless copper and other process steps are not necessary when manufacturing single-sided printed wiring boards.

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Single-Sided Board: A printed board with conductive pattern on one side only.

SIP (State Implementation Plan): A document prepared by each state describing existing air quality conditions and measures which will be taken to attain and maintain national ambient air quality standards.

Solder: An alloy that melts at relatively low temperatures and is used to join or seal metals with higher melting points. A metal alloy with a melting temperature below 427 degrees Celsius (800 degrees Fahrenheit).

Solder Mask: Nonpreferred term for solder resist (see resist).

Stationary Sources: Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit air pollutants.

Step-and-Repeat: A method by which successive exposures of a single image are made to produce a multiple image production master.

Test Coupon: A portion of a printed board or of a panel containing printed coupons used to determine the acceptability of such a board.

Toxic Hot Spot: An area where the concentration of air toxics is at a level where individuals may be exposed to an elevated risk of adverse health effects. Air toxics hot spots may include sources such as landfills, sewage treatment plants, and metal plating operations.

Underwriters Symbol: A logotype denoting that a product has been recognized (accepted) by Underwriters Laboratories Inc. (UL).

Use Cluster: A use cluster is a set of chemicals, processes, and technologies that can substitute for one another to perform a specific function.

Via: Term used to describe holes drilled through a printed wiring board for the purposes of layer-to-layer interconnection. The conductive pathway between layers is completed by plating vias with copper. It is customary to refer to holes drilled only for the purposes of interconnection as vias; other holes that may also provide interconnection but are also used for support of component leads or for tooling purposes are not generally called vias.

VOCs (Volatile Organic Compounds): Hydrocarbon compounds which exist in the ambient air. VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor, and some examples include gasoline, alcohol, and the solvents used in paints.

Void: The absence of any substances in a localized area.

Wave Soldering: A process wherein assembled printed boards are brought in contact with a continuously flowing and circulating mass of solder.

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